U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

POTENTIAL MINERAL RESOURCES, PAYETTE NATIONAL FOREST, IDAHO: DESCRIPTION AND PROBABILISTIC ESTIMATION

By

Arthur A. Bookstrom[1], Bruce R. Johnson[2], Theresa M. Cookro[3],
Karen Lund[3], Kenneth C. Watts[3], Harley D. King[3],
Merlin D. Kleinkopf[3], James A. Pitkin[3]
J. David Sanchez[3], and J. Douglas Causey[1]

Open-File Report 98-219a

1998

Prepared in cooperation with the U.S. Forest Service

[1]Spokane, WA 99201
[2]Reston, VA 22092
[3]Denver, CO 80225

SUMMARY: POTENTIAL MINERAL RESOURCES, PAYETTE NATIONAL FOREST (PNF)

The Payette National Forest (PNF), in west-central Idaho, is geologically diverse and contains a wide variety of mineral resources. Mineral deposit types are grouped into locatable, leasable, and salable categories. The PNF has substantial past production and identified resources of locatable commodities, including gold, silver, copper, zinc, tungsten, antimony, mercury, and opal. Minor lignitic coal is the only leasable mineral resource known to be present in the PNF. Resources of salable commodities in the PNF include sand-and-gravel, basalt for crushed-rock aggregate, and minor gypsum.

Locatable mineral resources are geographically divided between eastern and western parts of the PNF. The western PNF lies west of the Riggins-to-Cascade highway (US 95 - Idaho 55), and the eastern PNF is east of that highway. The western and eastern parts of the PNF are geologically distinctive and have different types of locatable mineral deposits, so their locatable mineral resources are described separately. Within the western and eastern parts of the PNF, locatable deposit types generally are described in order of decreasing geologic age.

An expert panel delineated tracts considered geologically permissive and (or) favorable for the occurrence of undiscovered mineral deposits of types that are known to be present within or near the PNF. The panel also estimated probabilities for undiscovered deposits, and used numerical simulation, based on tonnage-grade distribution models, to derive estimates of in-situ metals contained. These estimates are summarized in terms of mean and median measures of central tendency. Most grade and tonnage distributions appear to be log-normal, with the median lower than the mean. Inasmuch as the mean is influenced by the largest deposits in the model tonnage-grade distribution, the median provides a lower measure of central tendency and a more conservative estimation of undiscovered resources.

Mineral Endowment of the Western PNF

Table S-1 summarizes recorded production, identified resources, and estimated median and mean undiscovered resources (in tonnes of metal contained) for selected types of mineral deposits present in the western PNF.

High-grade Kuroko massive sulfide deposits of the western PNF, and their associated feeder veins and lower-grade disseminations, contain the largest identified resources of copper, zinc, and silver in the PNF (153,000 tonnes Cu, 370,000 tonnes Zn, and 1,200 tonnes silver), as well as 21 tonnes of gold. Estimated median and mean resources of undiscovered Sierran Kuroko-type deposits are 3,400 and 15,000 tonnes Cu, 2,600 and 32,000 tonnes Zn, 3.9 and 100 tonnes Ag, and 0 and 1.9 tonnes Au, respectively. However, the Kuroko-type Red Ledge deposits, as well as most of the known Sierran Kuroko-type prospects, and much of the geologically favorable tract for such deposits, are within the Hells Canyon - Seven Devils Scenic Area or the Hells Canyon Recreation Area. Those areas are closed to future mineral exploration and development.

Copper skarns and volcanic redbed-hosted disseminated copper-silver deposits have past production and identified resources of copper and silver (table S-1). However, many of the known mines and prospects, and much of the largest favorable tract are located within scenic and recreation areas that are closed to future mineral exploration and development. Polymetallic layers and veins of western-most PNF are similar to deposits just west of PNF, which contain large, low-grade resources of silver. Low-sulfide gold-quartz veins of the western PNF have relatively small recorded production (0.4 tonnes gold), and no identified resources. Estimated median and mean gold resources of undiscovered low-sulfide gold-quartz veins are 0 and 5.7 tonnes gold, respectively. Iron skarns of the western PNF have only small identified resources.

Gypsum layers and lenses of the western PNF have been mined on a small scale to produce agricultural gypsum for local markets. Basalt flows of the western PNF are an abundant and economical source of crushed-rock aggregate for construction and maintenance of roads.

Mineral Endowment of the Eastern PNF

Table S-2 summarizes recorded production, identified resources, and estimated median and mean undiscovered resources (in tonnes of metal contained) for selected types of locatable mineral deposits present in the eastern PNF.

Distal disseminated gold-silver deposits of the eastern PNF have the largest recorded production and identified gold resources in the PNF (89 tonnes gold). Development and production of identified resources of oxide ore is underway in the Stibnite mining area, and a Plan of Operations has been submitted for expansion of the Stibnite mines and heap-leach facilities. However, profitable operation of the proposed mines probably will require gold prices above about $11.25/g ($350/oz troy). Identified resources of sulfide gold protore are subeconomic at present, and probably will remain so until recovery processes improve and (or) gold prices rise substantially. Median and mean estimated gold resources of undiscovered distal disseminated gold-silver deposits also are substantial (6 and 24 tonnes gold, respectively). Several areas in the Edwardsburg, Profile, and Yellow Pine mining districts have been explored recently for distal disseminated gold resources. The known prospects are considered subeconomic at present. Exploration for distal disseminated gold deposits is expected to decline, unless gold prices are sustained above about $11.25/g ($350/oz troy).

Hot-spring gold-silver deposits of the eastern PNF have the second largest recorded production and identified gold resources in the eastern PNF (15.7 tonnes gold). In the Thunder Mountain mining district, the Sunnyside and Lightning Peak open pit mines and heap-leach facilities have recently been reclaimed, and a Plan of Operations has been submitted for development of the Dewey open-pit mine and heap-leach facility. Estimated median and mean gold resources of undiscovered hot-spring gold silver deposits are 11 and 39 tonnes gold, respectively. However, most of the favorable tract for undiscovered hot-spring gold-silver deposits lies within the Frank Church - River of No Return Wilderness Area. Most copper-gold mixed metal veins, and most opal occurrences also are located in the wilderness area, which generally is closed to future mineral exploration and development.

At least 150 exposures of copper-gold and gold-silver mixed-metal veins are present in the eastern PNF. The Meadow Creek vein at Stibnite produced 1.54 tonnes gold, 5.2 tonnes silver, and 3,180 tonnes antimony. The total recorded production of the veins of the Warren district is 2.92 tonnes gold and 20.7 tonnes silver. Clusters of such veins also are present in the Marshall Lake, Edwardsburg, Profile, and Yellow Pine mining districts, where they are expected to continue to attract exploration and mining activities by small companies and individuals. Estimated median and mean undiscovered resources are 1 and 2 tonnes gold, respectively, with minor associated silver, copper, zinc, lead, antimony, and (or) tungsten.

The Meadow Creek and Yellow Pine mines were important producers of antimony and tungsten. However, tungsten veins, antimony veins, and disseminated antimony deposits of the PNF are unlikely to become economic again in the foreseeable future, so little exploration activity is expected for such deposits per se. Nevertheless, distal disseminated gold-silver deposits commonly are associated with gold-silver mixed-metal veins, tungsten veins, antimony veins, disseminated antimony deposits, and mixed-metal skarns. Therefore, such deposits may be explored for potential bulk-mineable gold deposits, mostly in the Yellow Pine, Profile, and Edwardsburg mining districts.

Hot-spring mercury deposits, hosted in carbonate rocks of the Cinnabar Camp area, have recorded production of 440 tonnes mercury and identified resources of 370 tonnes mercury. Estimated median and mean undiscovered resources are 0 and 940 tonnes of mercury, respectively. However, mercury resources of the PNF are unlikely to be explored or developed in the foreseeable future. Environmental concerns about mercury have suppressed the use, market, and price of mercury. During 1995-1997 the U.S. Environmental Protection Agency conducted a major mercury removal action at Cinnabar Camp.

Recorded production of gold placers of the eastern PNF is 24 tonnes of gold, with an estimated 21 tonnes of silver. Identified resources are estimated as 1 tonne of gold. Undiscovered resources were not estimated, but large new discoveries are not expected. Recreational and small-scale gold-placer mining probably will continue intermittently, but no large-scale gold-placer developments are expected. Placer wastes and alluvial deposits are potential sources of sand-and-gravel aggregate in the eastern PNF.

Total Estimated Undiscovered Resources of the PNF

Total estimated undiscovered mineral resources of selected types of locatable mineral deposits of the PNF are summarized in Table S-3. Alternative estimates are given for levels of subjective probability that range from 90 percent to 1 percent. Median and mean total amounts of undiscovered ore are estimated as 36 and 57 million tonnes, respectively. Median and mean total contained metals are estimated as 43 and 74 tonnes gold, 150 and 560 tonnes silver, 44,000 and 140,000 tonnes copper, 2,600 and 32,000 tonnes zinc, 930 and 16,000 tonnes antimony, and 3,400 and 25,000 tonnes tungsten trioxide, respectively. These numbers represent estimated gross in-place metal resources of undiscovered deposits. The amount of metal that may become economically extractable depends on future metal prices, versus costs of exploration, development and production.

Table ST-1. Production, identified resources, and estimates of undiscovered resources of selected types of mineral deposits, western PNF

Deposit Type	Au	Ag	Cu	Zn	Pb	Sb	Fe	Ore
	(tonnes)							
Kuroko Massive Sulfide								
identified resources (m.s.)	5	480	54,000	170,000				6,000,000
identified resources (dissem.)	16	720	99,000	200,000				33,000,000
undiscovered, median	0	3.9	3,400	2,600	0			210,000
undiscovered, mean	1.9	100	15,000	32,000	7,100			840,000
Polymetallic Layers, Veins								
unrecorded production	yes	yes	yes	yes	yes	yes		yes
ident. res. (just outside PNF)		570						4,000,000
Disseminated Cu-Ag								
recorded production		16	7,100					907,000
identified resources		2.3	1,160					97,000
Low-sulfide Au-quartz								
recorded production	0.4							19,000
undiscovered, median	0							0
undiscovered, mean	5.7							840,000
Copper Skarn								
recorded production	0.1	7.1	960					38,000
identified resources	0.1	12	28,000					1,800,000
undiscovered, median	0	0	23,000					1,300,000
undiscovered, mean	2	16	130,000					9,600,000
Iron Skarn								
unrecorded production							yes	
identified resources							yes	160,000

Table ST-2. Production, identified resources, and estimates of undiscovered resources of selected types of mineral deposits, eastern PNF

Deposit Type	Au	Ag	Cu	Zn	Pb	Sb	Hg	WO_3	Fe	Ore
	(tonnes)									
Cu-Au mixed-metal Veins										
unrecorded production	yes	yes	yes						yes	yes
Au-Ag Mixed-metal Veins										
unrecorded production	yes	yes	yes	yes	yes	yes				yes
recorded production[1]	4	7				3,200				
undiscovered, median	1	0.1								59,000
undiscovered, mean	2	0.4								110,000
Distal Disseminated Au-Ag										
recorded production[2]	16	52								7,400,000
identified resources (oxide)	15									9,900,000
identified resources (sulfide)	58									22,500,000
undiscovered, median	6	0								5,000,000
undiscovered, mean	24	310								16,000,000
Antimony Veins										
recorded production						50				100
undiscovered, median						79				220
undiscovered, mean						2,200				7,900
Disseminated Antimony										
recorded production						31,000				3,100,000
undiscovered, median	0					0				0
undiscovered, mean	0.004					14,000				280,000
Tungsten Veins										
recorded production								7,800		1,100,000
undiscovered, median								3,400		400,000
undiscovered, mean								25,000		3,200,000
Hot-spring Gold-silver										
recorded production	3.7	4.8								1,300,000
identified resources	12									7,300,000
undiscovered, median	11	0								7,200,000
undiscovered, mean	39	130								26,000,000
Hot-spring Mercury										
recorded production							440			89,000
identified resources							370			120,000
undiscovered, median							0			0
undiscovered, mean							940			210,000
Gold Placer										
recorded production	24	21								410,000,000
identified resources	1									41,000,000

1. Warren district plus Meadow Creek vein.
2. Stibnite subdistrict minus Meadow Creek vein.

Table ST-3. Estimation of total resources of undiscovered deposits, PNF

Simulator Output for Total Tonnes of Undiscovered Commodities and Ores (in situ)						
	Percentile Measures of the Distribution					
Commodity (tonnes)	90%	**50% (Median)**	10%	5%	1%	**Mean**
Gold	5.7	**43**	180	260	500	**74**
Silver	2.9	**150**	1,300	2,400	7,300	**560**
Copper	1,400	**44,000**	370,000	640,000	1,400,000	**140,000**
Zinc	0	**2,600**	88,000	190,000	440,000	**32,000**
Lead	0	**0**	16,000	46,000	130,000	**7,100**
Antimony	0	**930**	46,000	93,000	200,000	**16,000**
Mercury	0	**0**	1,300	6,000	20,000	**940**
Tungsten trioxide	0	**3,400**	73,000	130,000	260,000	**25,000**
Ore	7,400,000	**36,000,000**	120,000,000	180,000,000	340,000,000	**57,000,000**

Information about Mineral Localities

Information about mineral localities identified by location or name can be found on the map (plate 1), and (or) in alphabetical listings of localities given in the map explanation and appendix A (as in the white pages of a telephone directory). Symbols on plate 1 and names in appendix A classify localities as either placers or lodes, and as either mines, prospects, or occurrences. For each locality, appendix A also lists commodities, deposit-type codes, and references.

Information about mineral localities identified by deposit type or mining district can be found in appendix B (as in the yellow pages of a telephone directory). Appendix B lists localities, sorted first by primary deposit-type code, second by alphabet, and third by secondary deposit-type code. Appendix B also gives location by mining district, commodities, ore minerals, and notes about the geological form of the mineral occurrence.

Additional information about deposit types and representative examples is in the text of the report. For each deposit type, the text gives some or all of the following: (1) a description and interpretation of the deposit type (as represented in the deposit-type model, and as present in PNF); (2) summaries of representative examples; (3) a rationale for delineation of permissive and (or) favorable tracts; (4) a rationale for numerical estimations; (5) a tabular summary of estimated metal resources of undiscovered deposits; (6) a development forecast, and (7) a discussion of environmental effects and implications.

CONTENTS

ILLUSTRATIONS

PLATE

FIGURES

TABLES

INTRODUCTION

Purpose and Objectives

The purpose of this study by the U.S. Geological Survey (USGS) is to provide the U.S. Department of Agriculture, Forest Service (USFS) with an assessment of undiscovered mineral resources of the Payette National Forest (PNF). This information is provided to assist the Forest Service in incorporating minerals information in forest plans as required by the National Forest Management Act (1976). Past production and identified resources of mines and prospects of the PNF are documented in a companion report by the U.S. Bureau of Mines (USBM, 1996).

The primary objectives of this study are to provide USFS with descriptions of the types of mineral deposits that are present or potentially present in the PNF, along with: (1) maps of showing locations of such deposits, and tracts that are permissive and (or) favorable for undiscovered deposits; (2) estimates of numbered numbers of undiscovered deposits, and of their probable contained resources; (3) explanations of rationales for tract delineation and numerical estimation; (4) forecasts of reasonably foreseeable development of mineral resources, and (5) comments on possible environmental effects of such development.

Secondary objectives of this study are to provide the USFS with the basic earth-science information on which the assessment is based. Such information is relevant to a wide range of ecosystem management issues and problems, such as slope stability, tree nutrition, fish and wildlife habitat, and land-use optimization. The basic earth-science information included in this and associated reports includes the following: (1) maps and listings of known mines, prospects, and mineral occurrences, classified by mineral-deposit type (this report, plate 1, and appendices A and B); (2) a digital geologic map of the PNF, prepared at 1:100,000 scale, with accompanying reports (Karen Lund, unpub. data, 1997); (3) a geochemical report and digital geochemical anomaly maps (Hopkins and others, 1996; K.C. Watts and H.D. King, unpub. data, 1997); and (4) a geophysical report and digital maps, including gravity, aeromagnetic, and aero-radiometric maps (M.D. Kleinkopf and J.A. Pitkin, unpub. data, 1997).

Project Activities

A team of earth scientists of the Mineral Resource Surveys Program of the U.S. Geological Survey (USGS) studied the geology and mineral deposits of the Payette National Forest (PNF) during 1992 to 1994. Completion of the project was delayed until 1997, because work on the project was interrupted in order to conduct a high-priority regional mineral-resource assessment for the Interior Columbia Basin Ecosystem Management Project (ICBEMP). Results of that regional assessment provide context for this study of the mineral resources of the PNF (See Bookstrom and others, 1996; Box and others, 1996; Zientek and others, in prep., 1997). Other USGS reports for the ICBEMP show how earth science information can be applied to ecosystem management issues and problems (See Raines and others, 1996; and Frost and others, 1996).

During 1992-94, Karen Lund integrated previous geologic maps with new geologic mapping to assemble a new geologic map of the PNF at 1:1,000,000 scale. Ken Watts and Harley King integrated previously acquired geochemical data with newly obtained data to construct geochemical maps used in the mineral-resource assessment. Dean Kleinkopf and Jim Pitkin integrated previously acquired gravity, magnetic, and aero-radiometric gamma-ray data to provide the geophysical maps used in this mineral-resource assessment. David Sanchez described known coal occurrences and reconnoitered for undiscovered coal. Bruce

Johnson queried the USGS Mineral Resources Data System (MRDS) to extract locations and geological attributes of known mines, prospects, and mineral occurrences of the PNF. Bruce Johnson, Art Bookstrom and Terry Cookro reviewed available literature on mineral resources of the PNF, and interviewed PNF foresters, and locally active geologists, prospectors, and miners to learn about recent and ongoing trends in mineral exploration and development in the PNF. They examined representative mineral localities, and plotted their locations on 1:24,000-scale topographic maps. They described the mineral localities, and classified them into groups of deposits with similar attributes (deposit types). In 1994 the entire assessment team used these data sets to delineate permissive and favorable tracts (by consensus), and estimated undiscovered mineral resources of various types likely to be present in the PNF (see methodology). In 1995 Art Bookstrom and Elwin Mosier collected samples of mine drainage waters for chemical analysis. In 1995-96 Karen Lund collected additional geologic information and refined the new geologic map of PNF. In 1996 Evan Arntzen digitized locations of mines and prospects that were visited and found to be different from those in existing MRDS records. In 1997 Pam Derkey and John Oblad made a digital representation of the new geologic map, Doug Causey made digital representations of mines, prospects, occurrences (pl. 1), and of permissive and favorable tracts (figs., this report) for mineral deposits of various types, and Art Bookstrom wrote this report. References to rock types in this report refer to lithologic units mapped by Karen Lund (unpub. data, 1997).

Geographic Setting

The PNF includes about 9,410 sq km of mountainous land, located in west-central Idaho (fig. 1), between about 44º 25’ and 45º 34’ N. latitude and 114º 43’ and 117º 03’ W. longitude (pl. 1). An additional 412 sq km of land under non-USFS ownership is located within the forest boundary. The PNF is bounded on the northeast by the Salmon River, and on the northwest by the Snake River, which marks the Idaho-Oregon border. The PNF is contiguous with the Nez Perce National Forest (NF) to the north, the Wallowa Whitman NF to the west, the Salmon NF to the east, and the Boise NF to the south (USFS 1994). PNF headquarters are in McCall, Idaho.

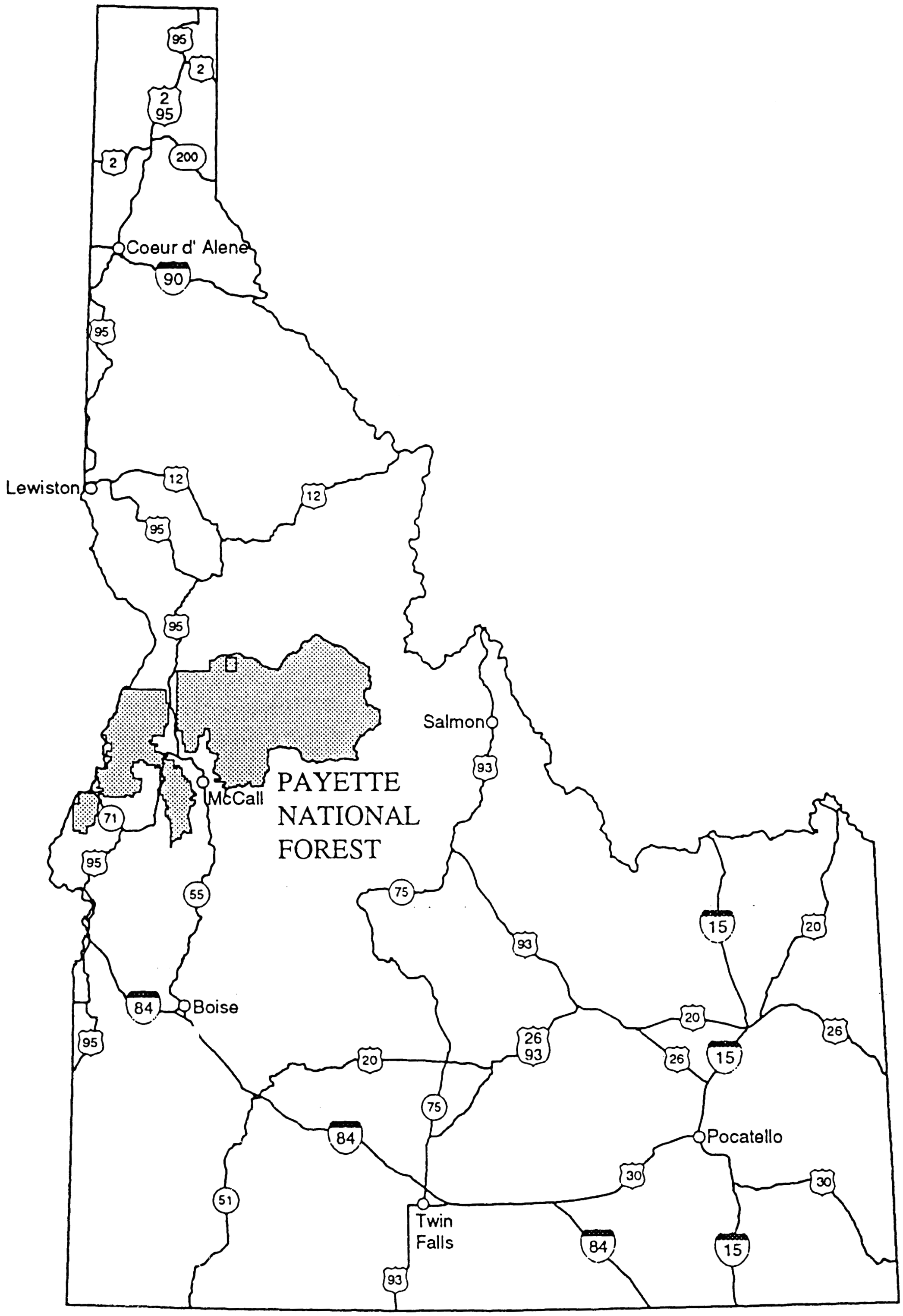


Figure 1. Map of Idaho showing the location of the Payette National Forest, (after USBM, 1996).

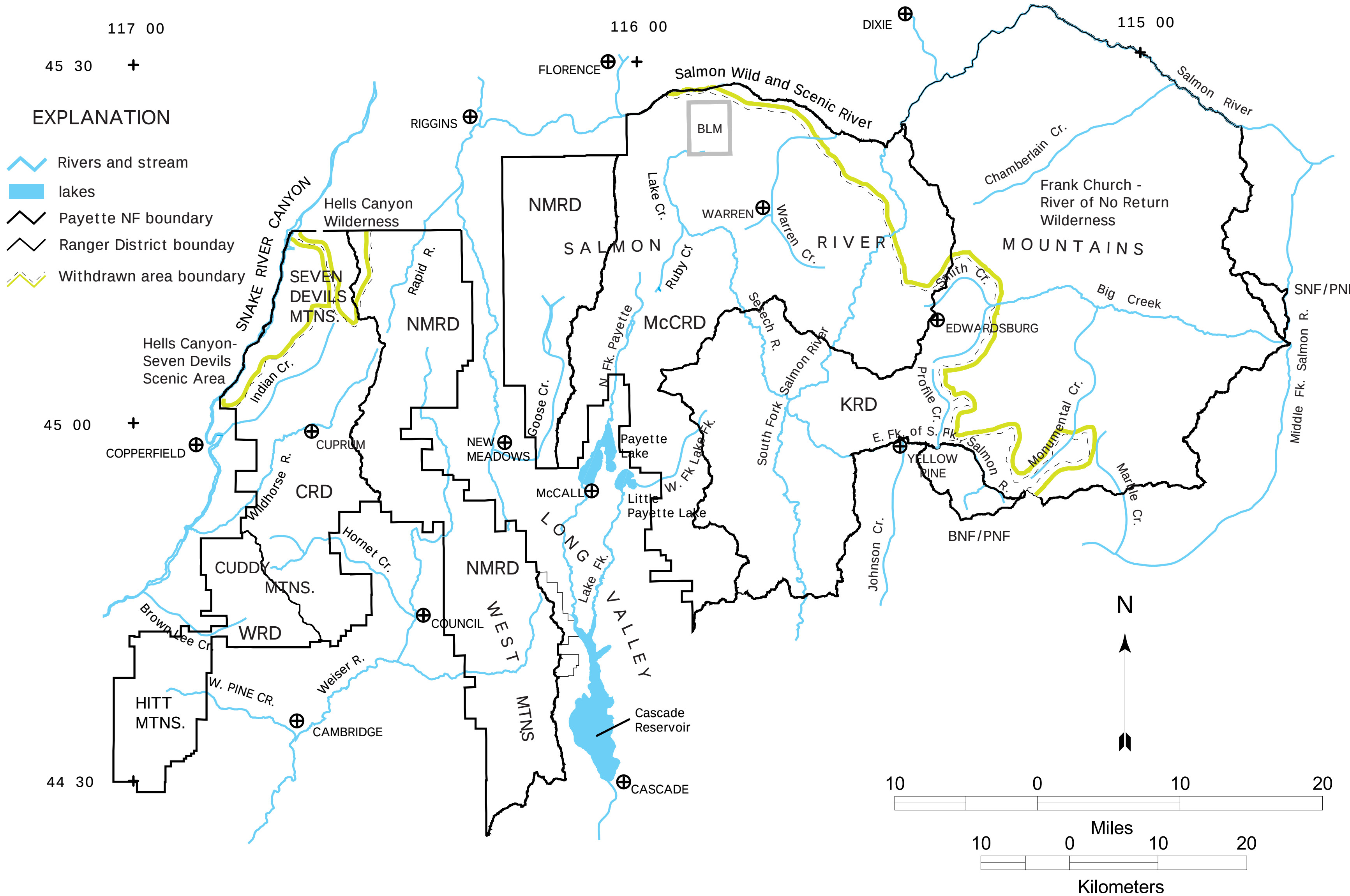
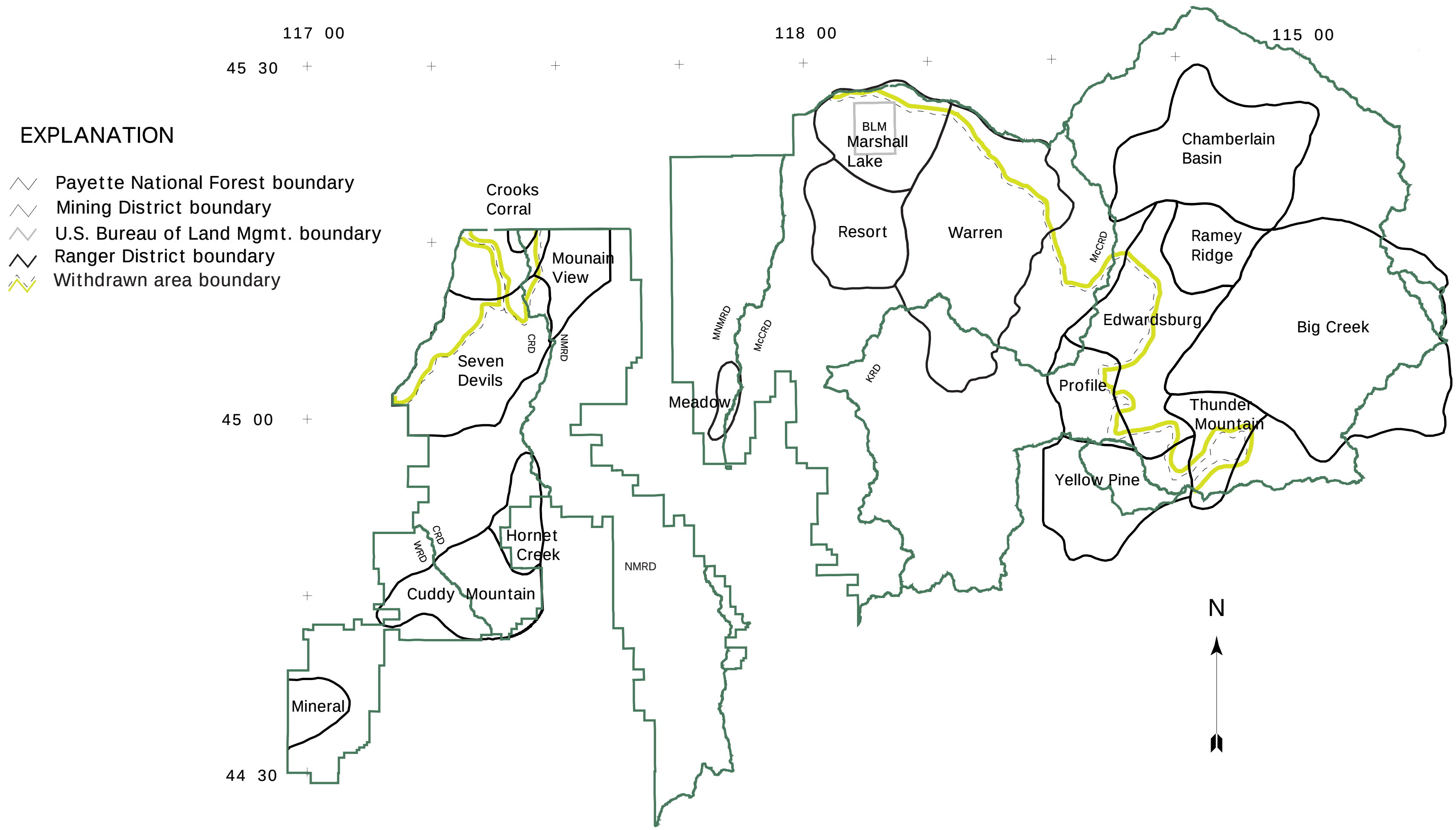


Figure 2. Diagrammatic map showing boundaries of the PNF, Ranger Districts, and areas withdrawn from mineral development, in relation to geographic features of the area. Ranger District (RD) names are: Weiser RD=WRD, New Meadows RD=NMRD, McCall RD=McCRD, Krassel RD=KRD. Areas outside PNF but administered by PNF are: Boise NF administered by PNF (BNF/PNF) and Salmon NF administered by PNF (SNF/PNF).



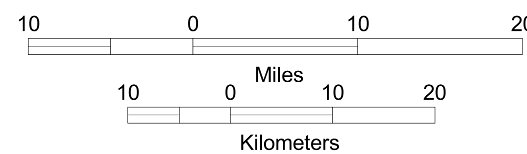


Figure 3. Map showing locations of mining districts in the PNF, (Ranger Districts abbreviated as in figure 2).

As shown in figure 2, the western PNF is separated from the eastern PNF by Meadows Valley (of the Little Salmon River) and Long Valley (of the Payette River). The western PNF includes the West, Seven Devils, and Cuddy Mountains, but excludes the valleys of the Little Salmon and Weiser Rivers, and the Snake River south of Homestead, Oregon. The western PNF is covered by the Weiser, Council, and western New Meadows Ranger Districts. The Hells Canyon National Recreation Area, the Hells Canyon - Seven Devils Scenic Area, and the Rapid River Wild and Scenic River area are in the northwestern part of the western PNF. The eastern PNF includes the western Salmon River Mountains, which are covered by the eastern New Meadows, McCall, and Krassel Ranger Districts. The Salmon Wild and Scenic River area is along the northern boundary of the eastern PNF, and the Frank Church - River of No Return Wilderness Area covers about the eastern third of the eastern PNF (plate 1, and Forest Visitor/Travel Maps: USFS 1995a, 1995b).

Mining districts in PNF Ranger Districts

Mining districts are areas in which local miners and prospectors organized themselves for recordation of mining claims. Boundaries of mining districts generally are indefinite, and commonly resulted from an interplay of factors, including spatial clustering of mineral deposits, historical clustering of discoveries, locations of access routes and topographic barriers, and development of socio-economic organizations of miners, prospectors, business people, and politicians. Ross (1936) made a map of the mining districts of Idaho, based on his knowledge of general usage at that time. The boundaries on that map provide a consistent framework for description of general locations of mines and prospects in Idaho. The mining district boundaries on plate 1 are from Ross (1936) and are the same as those used in a recent description of mines and prospects of the PNF by the U.S. Bureau of Mines (USBM, 1996).

The Weiser Ranger District (RD) includes the Mineral mining district and the southwestern part of the Cuddy Mountain mining district (fig. 3 and pl. 1). The Weiser RD is in the southwest corner of the PNF. It lies mostly in Washington County, Idaho, and it covers the Hitt Mountains and the southern part of the Cuddy Mountains.

The Council RD includes the northern part of the Cuddy Mountain mining district, the north and west parts of the Hornet Creek mining district, most of the Seven Devils mining district, the northeast part of the Homestead mining area (undefined), and the south end of the Crooks Coral mining district (fig. 3 and pl. 1). The Council RD is along the northwestern margin of the PNF. It lies in Adams and Washington Counties, Idaho, and covers the northern part of the Cuddy Mountains and the Seven Devils Mountains. The Council RD includes parts of the Hells Canyon National Recreation Area and the Hells Canyon - Seven Devils Scenic Area. Those areas are withdrawn from mineral entry.

The west part of the New Meadows RD includes the eastern part of the Seven Devils mining district, and the Mountain View mining district, and the east part of the New Meadows RD includes the Meadows mining district (fig. 3 and pl. 1). The western part of the New Meadows RD is west of the Meadows and Long Valleys, in Adams County, Idaho. It lies east of the Council RD, and it covers the eastern part of the Seven Devils Mountains, and the West Mountains. The eastern part of the New Meadows RD is east of the Meadows and Long Valleys, in Adams and Idaho Counties, Idaho. It covers the western margin of the Salmon River Mountains.

The McCall RD includes the Resort, Marshall Lake, and Warren mining districts, but part of the Marshall Lake mining district (T 24 N, R 5 E) is administered by the U.S. Bureau of Land Management (fig. 3 and pl. 1). The McCall RD surrounds the west, north, and east sides of Payette Lake, in Valley and Idaho Counties, Idaho. It covers the west and northwest parts of the Salmon River Mountains, east of Long Valley, and north and northeast of Payette Lake to the Salmon River between French Creek (on the west) and Haney Bar (on the east). The northeastern margin of the McCall RD is included in the Frank Church - River of No Return Wilderness area, the boundary of which follows the south rim of the canyon of the Salmon River, and extends southeast from Nelson Point to Wolf Fang Peak. The Salmon Wild and Scenic River corridor also follows the Salmon River along the north boundary of the McCall RD. Those areas are withdrawn from mineral entry.

The Krassel RD includes the Yellow Pine, Thunder Mountain, Profile, Edwardsburg, Big Creek, Ramey Ridge, and Chamberlain Basin mining districts. The Stibnite subdistrict of the Yellow Pine mining district is in a part of the Boise NF that is administered by the Krassel RD (fig. 3, pl. 1). The Krassel RD is in the Salmon River Mountains, south and east of the McCall RD, in Valley and Idaho Counties, Idaho. The eastern 2/3 of the Krassel RD lies within the Frank Church - River of No Return Wilderness area, which is withdrawn from mineral entry. The withdrawn area includes most of the Thunder Mountain mining district, the east half of the Edwardsburg mining district, and all of the Big Creek, Ramey Ridge, and Chamberlain Basin mining districts. However, the central part of the Thunder Mountain mining district and an access corridor to it are excluded from the wilderness area, and are open for mineral entry and development.

Previous Studies

Previous regional studies that include information on the geology and mineral resources of PNF include the following: (1) Lorain and Metzger (1938), on placer gold; (2) Savage (1961), on black-sand placers; (3) Cater and others (1973), on mineral resources of the Idaho Primitive Area; (4) Ridenour (1985), on mineral resources of the Frank Church - River of No Return Wilderness area; (5) Fisher and Johnson (1995a), on the geology and mineral resources of the Challis 1^{o} x 2^{o} Quadrangle; (6) Box and others (1996), on mineral resources of the Interior Columbia Basin; and (7) USBM (1996), on mines and prospects in PNF.

Previous studies on the geology and mineral resources of the Mineral mining district include those by Turner (1908), Anderson and Wagner (1952), Mackin (1953), and Hendricksen (1975). Studies on the Cuddy Mountain and Hornet Creek mining districts include those by Livingston (1923), Fankhauser (1964), Bruce (1971), and Mangham (1994). Studies on the Seven Devils mining district and (or) the Homestead mining area (undefined) include those of Livingston and Laney (1920), Cook (1954), Morganti (1972), Close (1993), and Fifarek and others (1994).

Previous studies on the geology and mineral resources of the Resort and Marshall Lake mining districts include studies on placers by Capps (1940, 1941), and Beuhler and others (1993), and studies on lodes by May (1984), and Murray (1979). Studies on the Warren mining district include those by Reed (1937), Capps (1941), and Beuhler and others (1993). Studies on the Yellow Pine mining district include those of Schrader and Ross (1926), Leonard (1965, 1973, 1980), Leonard and Erdman (1983), and Cookro (1985). Studies on the Stibnite subdistrict of the Yellow Pine mining district include those by Cooper (1951), Cookro and others (1988), USDA Forest Service (1994), and Mitchell (1995). Studies on the Thunder Mountain mining district include those of Umpleby and Livingston (1920), Shenon and Ross (1936), Leonard and Marvin (1982), Adams (1985), Johnson and Fisher (1995), USMX (1997), and Parsely (1997). Studies on the Edwardsburg, Profile, Ramey Ridge, and (or) Big Creek mining districts include those by

Shenon and Ross (1936), Leonard and others (1967), Kirkpatrick (1975), and Gammons (1988).

Definitions

Mineral resources are natural sources of minerals and (or) mineral materials that are, or that contain potentially useful or valued commodities.

Identified (or discovered) mineral resources are sources of mineral commodities whose location, quality, and quantity are known or estimated from specific geologic evidence (Menzie and Singer, 1990). *Extensions of identified resources* are potential mineral resources that are closely related to identified mineral deposits, both spatially and geologically. Identified resources include *inferred* resources, and *demonstrated* resources, which can be further classified as *measured* or *indicated* resources (U.S. Bureau of Mines and U.S. Geological Survey, 1980). Identified resources have economic potential but may be economic, marginally economic, or subeconomic. *Reserves* are identified resources from which minerals can be extracted profitably with existing technology and under present economic conditions (Brobst and Pratt, 1973).

Undiscovered mineral resources are potential sources of mineral commodities, for which either the location, quality, or quantity are unknown.

The *mineral endowment* of an area is the total of its mineral resources of a given type, including past production, identified resources, and undiscovered resources (Harris, 1984).

A *mine* is an excavation for the extraction of minerals (Bates and Jackson, 1987). Mines commonly are evidenced by mine workings, waste dumps, and (or) production records.

A *mineral prospect* is an area that is a potential site of mineral deposits, based on preliminary exploration (Bates and Jackson, 1987). Mineral prospects commonly are evidenced by exploration workings, such as adits, pits, trenches, or drill sites.

A *mineral occurrence* is a concentration of a mineral or mineral material that is considered valuable by someone somewhere, or that is of scientific or technical interest (Cox and Singer, 1986). Mineral occurrences commonly are evidenced by surface showings, geochemical anomalies, mining claim locations, or written descriptions.

A *mineral deposit* has been defined as either: (1) a mass of naturally occurring mineral material, such as metal ores or nonmetallic minerals, usually of economic value, without regard to mode of origin (Bates and Jackson, 1986); or (2) an accumulation of associated mineralized bodies that resulted from a common set of mineralizing processes (paraphrased from Barton and others, 1982); or (3) a mineral occurrence of sufficient size and grade that under the most favorable circumstances, could be considered to have economic potential (Cox and Singer, 1986). The third definition is most relevant to USGS mineral resource assessments, based on mineral deposit models.

A *mineral deposit model* consists of systematically arranged information describing the essential attributes (properties) of a class of mineral deposits, which share a large number and wide variety of attributes (Cox and Singer, 1986). Models are constructed from data for well-studied examples of a deposit type. A *descriptive model* outlines salient characteristics of the deposit type, and the geological environments in which such deposits are present. It provides a basis for classification of similar deposits, and for delineation of tracts considered permissive for the occurrence of such deposits. A *grade-tonnage model* demonstrates ranges of grades and tonnages of ore produced from deposits of a given type. Such models provide a basis for estimation of resources of undiscovered deposits.

Ore is a naturally occurring material from which a mineral or minerals of economic value can be extracted at a reasonable profit. *Ore minerals* are the part of an ore, usually metallic, which is economically valuable, as contrasted with *gangue minerals* , which accompany the ore minerals but are not economically valuable (Bates and Jackson, 1987).

An *ore deposit* is a mineral deposit that has been tested and is known to be of sufficient size, grade and accessibility to be producible and yield a profit (Cox and Singer, 1986).

A *mineral locality* is the location of a mine, prospect, or mineral occurrence, which may or may not contain ore, as defined by current economic conditions.

A *lode* is a mineral occurrence or deposit that is hosted in consolidated bedrock (Bates and Jackson, 1987). Lode mining claims are on deposits that are encased in or surrounded by hard rock, such as stratiform layers, veins, or disseminations (Pruitt, 1981).

A *placer* is a mineral occurrence or deposit in which the mineral or minerals of value are contained in loose, unconsolidated material, such as gravel. Placer mining claims are located on such deposits and certain consolidated sedimentary rocks that lie at the surface (Pruitt, 1981).

METHODOLOGY

At the request of USFS, the USGS has developed a systematic methodology to provide quantitative assessments of undiscovered mineral resources, using what is now called the three-part form of quantitative assessment (Singer, 1992a; Menzie and Singer, 1990; Singer and Cox, 1987; Ludington and others, 1992). The following summary of the methodology is paraphrased from Hammarstrom and others (1993). The three parts involved in quantitative assessment of undiscovered mineral resources are as follows:

(1) *permissive tracts* are delineated according to the types of deposits that are permitted by the geology;
(2) a *mineral deposit model* for each permitted deposit type is matched to the geologic, grade, and tonnage characteristics of identified deposits of that type in the interest area;
(3) numbers of undiscovered mineral deposits are estimated for each deposit type.

Parts 2 and 3 result in probability distributions of numbers of deposits, tonnages of deposits, and metal grades. Sampling of these distributions by computer simulation provides estimates of tonnes of metal in potential undiscovered mineral deposits.

Mineral deposit models are the basis for delineating permissive tracts, selecting grade and tonnage models, and estimating undiscovered deposits. This methodology can only be used if sufficient data are available to identify the types of deposits present in the area of interest, and if appropriate grade and tonnage models exist for the deposit types identified.

Permissive, Favorable, and Assessment Tracts

Definition of permissive, favorable, and assessment tracts is based on mineral deposit models and geologic knowledge of the study area. A descriptive mineral deposit model is used to identify features that are required for the occurrence of mineral deposits described by the model. Geologic knowledge is used to define tracts that have the required features. Such knowledge may include field experience, information from the geologic literature, geologic maps, geochemical and geophysical anomaly patterns, and information on known mines, prospects and mineral occurrences, as well as information on the history of minerals-exploration activities and results in the study area. A grade-tonnage mineral deposit model, which indicates the range of sizes and grades of deposits that have been well explored and (or) developed in the past, is used to define the range of grade and tonnage of deposits for which numbers of undiscovered deposits are estimated.

Permissive tracts are areas that are considered permissive for one or more deposit types, such that the probability that a deposit (large enough to lie between the 20th and 80th percentiles of the tonnage-grade model) lies outside the tract boundary is negligible, that is, less than 1 in 100,000 to 1,000,000" (Singer, 1993). Areas are delineated as permissive where the geology permits the existence of deposits of one or more specified types. Delineation of permissive tracts is guided by the presence of known mines, prospects and occurrences, and by geologic criteria derived from deposit models, based on studies of known deposits within and outside the study area. Permissive tracts, many of which are regional in size, are described in the text, but generally are not shown on illustrations in this report. For digital maps of regional permissive-tract boundaries, the reader is referred to Box and others (1996), a regional assessment of undiscovered mineral resources of the Pacific Northwest, done for the Interior Columbia Basin Ecosystem Management Project

Favorable tracts are areas that are considered favorable for one ore more deposit types, such that they have a non-trivial probability (more than 1 in 20 to 1 in 100 chance) for the occurrence of a mineral deposit of the type(s) and tonnage-grade range(s) implied by the deposit-type model(s) being applied. Favorable tracts tend to be defined on the basis of active criteria, such as the presence of mines and prospects, claim blocks, alteration patterns, and (or) geochemical or geophysical anomalies, indicative of the presence of mineral deposits of the type being considered (Greg Spanski, written commun., 1997).

Assessment tracts are favorable tracts for deposit types with available descriptive and grade-tonnage models, for which quantile-type estimates of numbers of undiscovered deposits can be made (Barton and others, 1995; Brew, 1992). An assessment tract may include geographically separated subunits. In such cases, the assessment applies to the entire composite assessment tract, and not to each subunit, individually.

Estimation of Numbers of Undiscovered Deposits

If sufficient data are available to indicate that additional deposits are likely to be present within the assessment tract, estimates of numbers of undiscovered deposits are made by an assessment team. The authors of this report (except for J.D. Causey) comprised the assessment team for this study. Estimates were made for deposits within assessment tracts and within 1 km of the surface. After full discussion of relevant information available, estimates were made in terms of subjective probabilities that at least a given number of deposits are present at a specific confidence level. Each team member was asked to estimate the minimum number of undiscovered deposits for a range of fixed levels of confidence, or subjective probability (the 90^{th}, 50^{th}, 10^{th}, 5^{th}, and 1^{th} percent confidence levels, where 90 percent represents a high degree of certainty and 10 percent or less represents a low degree of certainty). Probability estimates are based on the assumption that undiscovered deposits can be characterized by existing grade and tonnage models for a given deposit type. The estimator assumes that 80 percent of the undiscovered deposits will lie between the 90th and 10th percentile values on the grade and tonnage curves for the appropriate model.) Each team member estimated the minimum number of deposits expected at each confidence level, and the estimates for each confidence level were averaged to arrive at a team estimate. If the spread of individual estimates was large, the extreme estimators were asked to justify their estimates. Discussion of the estimation criteria was re-opened, and the estimation process was repeated. Finally, the average estimate was entered into a formula used to approximate the mean number of deposits to be predicted by the Monte Carlo computer simulator (Root and others, 1992), to test whether that number was a reasonable expression of team opinion. If not, an effort was made to understand why not, and another iteration of the team estimation process was performed.

Numbers of undiscovered deposits were generally estimated by informally combining target-counting and internal deposit-density approaches. In target counting, the following factors were taken into consideration: (1) number and quality of exploration targets, indicated by (a) number, characteristics, and exploration histories of known mines, prospects, and occurrences; (b) number, qualities and sizes of favorable geologic characteristics such as favorable structural settings, rock types, minerals, alteration assemblages, and (or) weathering products, indicative of mineral deposits of the type in question; (c) number, qualities and sizes of geochemical and (or) geophysical anomalies indicative of the deposit type in question. The internal deposit density approach was used sparingly and locally to extrapolate spacings of exposed deposits into adjacent or nearby areas, where bedrock is hidden by overlying materials.

Estimation of Ore and Metal in Undiscovered Deposits

Estimated numbers of deposits are combined with a Monte Carlo computer simulator (MARK3 program) that utilizes grade and tonnage models to provide a probability distribution of the ore and metal tonnages in undiscovered deposits (Root and others, 1992). The simulator performs 4,999 iterations using a random number generator to sample the number of deposits, grades and tonnages in a cycle, and sorts the results to allow reporting of ore and metal tonnages for a range of percentiles of the distribution.

The *mean* is the total amount of ore or metal obtained in the simulation divided by the number of cycles (4,999). Mean values are additive, so the mean amounts of gold predicted for different types of gold deposits can be added to give a sum of the means of predicted amounts of gold. However, the mean may overestimate the actual, because most frequency distributions of grades and tonnages are asymmetric, with tails toward larger values that represent uncommonly large or high-grade deposits. Furthermore, the lowest values in a grade or tonnage frequency distribution (or model) are truncated, because mineral deposit models are based on deposits that have some possibility of being economic.

The *median* (50th percentile) values represent a midpoint in the simulation (In half of the cases the predicted undiscovered deposits would have deposit tonnages and metal contents greater than the median value, and in half of the cases they would contain less.). The ore and metal tonnages from the 4,999 cycles of each simulation are sorted and ranked to provide percentile values. Median values may represent more reasonable estimates for undiscovered resources than mean values, when considered in relation to demonstrated resources and past production. However, median values (or any other percentile values) are not additive because they reflect a ranking within a particular simulation. Users of these statistics must chose the most appropriate values (90th, 50th, 10th percentile or mean) commensurate with their needs.

No quantitative assessments of undiscovered mineral resources were made for many types of mineral deposits present in the PNF, because (1) no appropriate grade and tonnage models are available for many types of mineral deposits of the PNF; or because (2) potential mineral resources that are closely related to identified mineral deposits, both spatially and geologically, are more properly treated as extensions of identified resources, rather than as undiscovered resources. Potential extensions of known deposits are discussed, but the three-part method for assessment of undiscovered resources cannot be properly applied to them, because they are not entire deposits, and to treat them as such would yield excessively large estimates of their potential resources.

Sampling and Analysis of Mine-drainage Waters

Samples of mine-drainage water, springs, and (or) groundwater from monitoring wells were collected from mines, prospects, and mill tailings in August and September of 1994. Samples were taken from the Red Ledge prospect, Copper Cliff mine, Warren vein and placer deposits, Stibnite mining area, Cinnabar Camp, and Thunder Mountain mining area. Temperature, pH, dissolved oxygen, and specific conductance were measured at each sample site, and titrations for acidity and alkalinity were done in the field. For each site, the following samples were analyzed: (1) unfiltered sample (shaken to suspend sediment, and HNO_3^- acidified to prevent precipitation) for analysis of total metals by Induced Coupled Plasma (ICP) Emission Spectrometry (ICPES) and (or) Mass Spectrometry (ICPMS); (2) 0.2-micron-filtered sample for analysis of dissolved constituents, as follows: (a) HNO_3^- acidified subsample for analysis of dissolved metals by ICP-ES and ICP-MS; (b) HCl^- acidified subsample for analysis of dissolved Fe^{2+}; (c) chilled subsample for analysis of dissolved anions; and (d) subsample + barium chloride solution (to precipitate $BaSO_4$), for analysis of SO_4^{2-}. Selected samples also were treated with potassium dichromate and analyzed for mercury by cold-vapor atomic absorption. Key results from Bookstrom and Mosier (unpub. data, 1995) are summarized in environmental sections of this report.

Metric Units, Conversion Factors, and Rounding

The International System of Units, a modernized metric system of measurement, is used in this report, as recommended by the Metric Conversion Act of 1975. To convert from inch/pound (U.S. customary) to SI (metric) units, the following conversion factors were used: <u>for length</u>, inch (in) = 25.4 mm; foot (ft) = 0.3048 meter (m); mile (mi) = 1.609 kilometers (km); <u>for area</u>, 1 acre = 0.405 hectare, or 0.00405 sq km; <u>for volume</u>, cubic yard (cu yd) = 0.7646 cubic meters (cu m); <u>for mass</u>, troy ounce (oz) = 31.1035 grams (g), pound avoirdupois (lb avdp) = 0.4536 kg, short ton (st = 2,000 lb) = 0.9072 metric tonne (t); <u>for temperature</u> (^{o}F - 32)/1.8 = ^{o}C; <u>for alkalinity</u>, meq/L = milli-equivalence (of protons required to titrate a bicarbonate-carbonate solution)/Liter of solution. Production reported in dollars was converted to units of mass, using the price per unit of mass for the time interval reported. Past production and identified resources are rounded to 3 significant figures. Estimation of undiscovered resources is reported to 2 significant figures.

GEOLOGIC SETTING

The following summary is based on a geologic map of the PNF, and its accompanying explanation of units, made to provide the geologic framework for delineation of permissive and favorable tracts for this study (Karen Lund, unpub. data, 1997).

Regional Provinces, Terranes, and Features

Blue Mountains Island Arc Accreted Terranes

Metavolcanic and metasedimentary rocks of the western PNF are interpreted to have formed in the oceanic *Blue Mountains Island Arc*, of Permian-Triassic age, which collided with and was accreted to the western margin of the North American continent in Jurassic-Cretaceous time (Vallier and Brooks, 1994). Four separately accreted terranes (from oldest to youngest -- the Baker, Wallowa, Olds Ferry, and Izee terranes) comprise the part of the Blue Mountains Island Arc that is exposed in the western PNF. Metavolcanic and metasedimentary rocks of the Blue Mountains Island Arc contain many stratabound and (or) stratiform mineral deposits that formed during island-arc volcanism and sedimentation, and have been deformed and metamorphosed along with the accreted terranes that contain them. Mafic to intermediate intrusions of Jurassic to Cretaceous age also are common in the accreted terranes. The intrusions tend to be less deformed and metamorphosed than their metavolcanic and metasedimentary host rocks, and they commonly contain inclusions of those host rocks. Some of the intrusions are spatially associated with mineral deposits.

Suture Zone

A wide *Suture Zone* underlies the north-trending boundary between accreted terranes to the west, and the North American continental province to the east. The suture zone includes highly deformed and metamorphosed rocks of the Blue Mountains Volcanic-arc Accreted Terrane, the North American Continental Province, and the west margin of the Idaho Batholith. The suture zone is interpreted as the zone along which the oceanic Blue Mountains Volcanic-arc was accreted to the North American continent. The west margin of the Idaho Batholith is metamorphosed and foliated parallel to the suture zone, which indicates that it was emplaced while the suture zone was still tectonically active. The suture zone locally contains minerals such as corundum, indicative of crystallization at high-pressure.

North American Continental Province

The *North American Continental Province* underlies the eastern part of the PNF (figs. 4 and 5). Exposed bedrock consists of metamorphic rocks of Late Precambrian to Early Paleozoic age, stocks of disputed age (Ordovician ? or Tertiary ?), the Idaho Batholith of Cretaceous age, and stocks, dikes, and volcanic rocks of Tertiary age.

Metamorphic Rocks

Metamorphic rocks of the North American Continental Province in PNF are predominantly metasedimentary rocks and minor metavolcanic rocks, which range from Late Proterozoic to Paleozoic in age. Rock types include quartzite, feldspathic quartzite, meta-conglomerate, metagraywacke, phyllite, amphibolite, micaceous schist, andalusite-mica schist, garnet-mica schist, biotite gneiss, dolostone, marble, tremolitic marble, calc-silicate gneiss, and skarn and hornfels (Karen Lund, unpub. data, 1997). These are the metamorphic country rocks that host the Idaho Batholith. They also are present as roof pendants and inclusions within the Idaho Batholith.

Idaho Batholith

The Atlanta (southern) lobe of the *Idaho Batholith* underlies much of the eastern PNF, where it consists of various types of igneous intrusive rocks, including early tonalite and foliated granodiorite (95-85 Ma), porphyritic biotite granodiorite (88 to 82 Ma), and late biotite-muscovite granite (78-72 Ma), (Karen Lund, unpub. data, 1997). In the PNF, early tonalite and foliated granodiorite are predominant along the western margin of the Atlanta lobe of the Idaho Batholith. Porphyritic biotite granodiorite is predominant in its central part, and late granites are relatively common near its northern and eastern margins. Metamorphic roof pendants, inclusions, and hydrothermal mineral deposits also are relatively common near the northern and eastern margins of the Atlanta Lobe of the Idaho Batholith in the PNF.

Isotopic age determinations on late biotite-muscovite granite of the Idaho Batholith have about the same range (78 to 72 Ma) as age determinations on sericite from batholith-hosted veins and silica-sericite altered rocks (mostly 79 to 69 Ma, according to Gammons (1988). This suggests that most batholith-hosted mineralization is related to intrusions of late two-mica granite of the Idaho Batholith. That granite is peraluminous in composition (Reed Lewis, pers. commun., 1998). It is interpreted here as an S-type granite, generated largely by partial melting of continental crustal metasedimentary rocks. Associated hydrothermal deposits commonly contain gold-, silver-, base-metal, arsenic-, antimony-, and (or) tungsten-bearing minerals.

Eocene Intrusions

Eocene Intrusions are common near the eastern margin of the Idaho Batholith. Eocene intrusions include dikes, dike swarms, and stocks. The stock of Chamberlain Basin is the largest of these intrusions. Eocene intrusions generally are porphyritic in texture and intermediate to felsic in composition (including porphyritic diorite, granodiorite, and granite, as well as dacite, quartz latite, and rhyolite porphyries, which range in age from 51 to 39 Ma). Most of the Eocene intrusions in PNF are not significantly mineralized, and are only weakly altered. Locally they transect veined and silicified rocks of the Idaho Batholith and its metasedimentary inclusions and pendants. The large stock of Chamberlain Basin contains a few widely scattered metal-bearing pegmatites and polymetallic veins.

Thunder Mountain Caldera of the Challis Volcanic Field

The *Thunder Mountain Caldera* (or Cauldron Complex) of the Challis Volcanic Field lies in the southeastern corner of the PNF. It consists of predominantly felsic volcanic, pyroclastic and epiclastic rocks that were erupted and deposited in subaerial and lacustrine environments during Eocene time (51 to 43 Ma). It contains hot-spring gold-silver deposits of the Thunder Mountain district, and it probably is related to hot-spring mercury deposits, hosted in Proterozoic metasedimentary rocks near the western margin of the volcanic field.

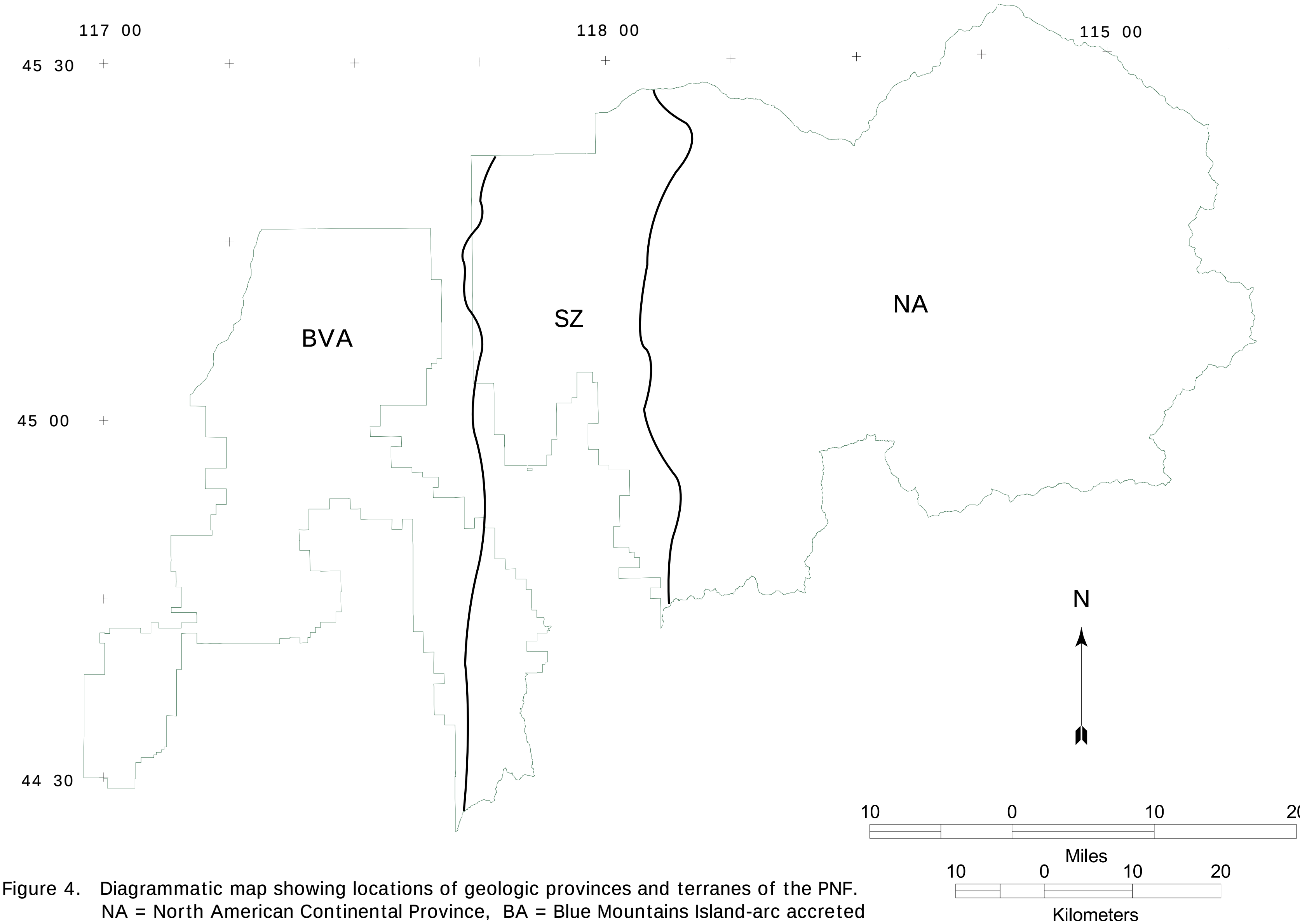


Figure 4. Diagrammatic map showing locations of geologic provinces and terranes of the PNF. NA = North American Continental Province, BA = Blue Mountains Island-arc accreted terranes, SZ = Suture Zone.

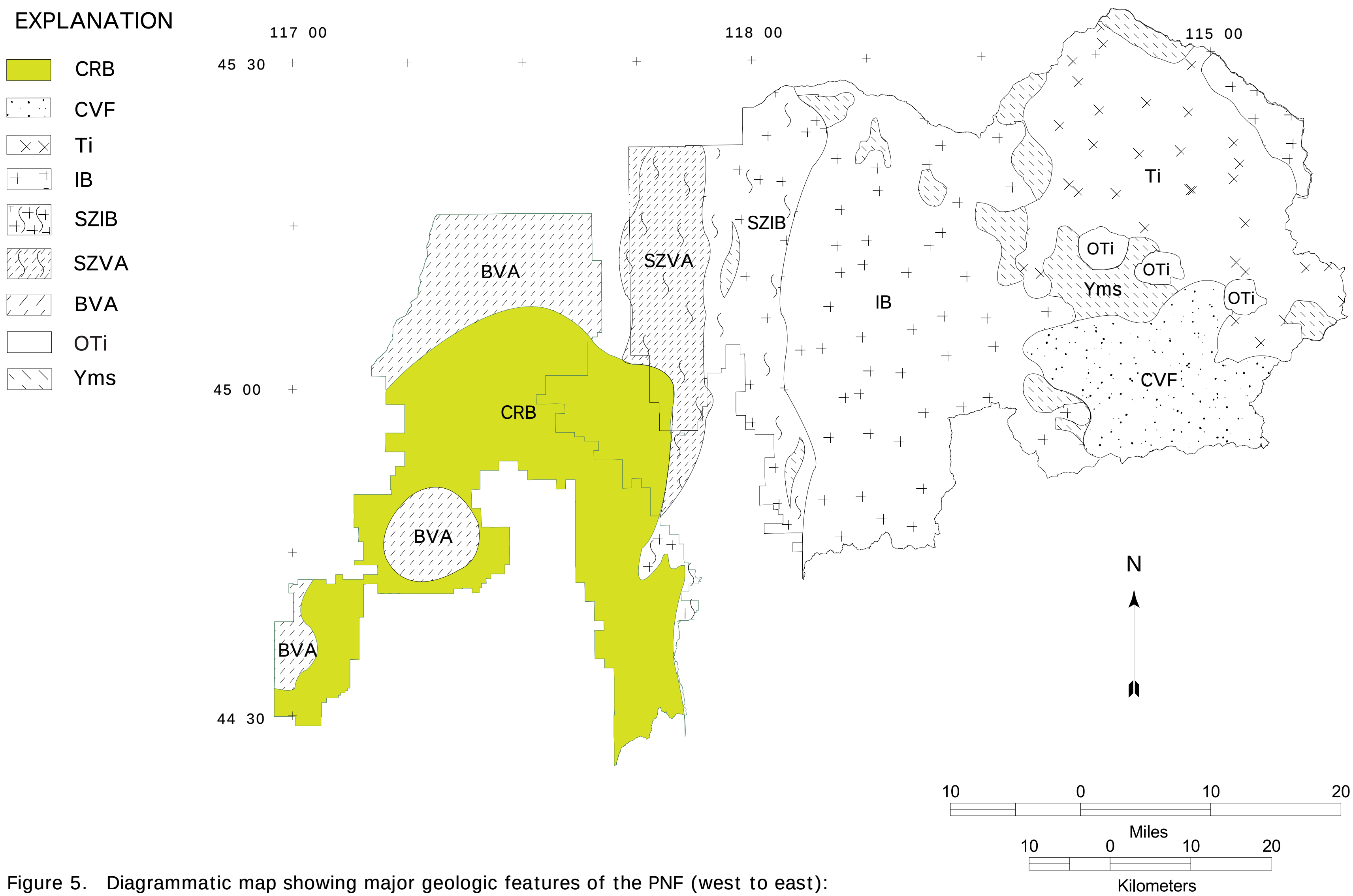


Figure 5. Diagrammatic map showing major geologic features of the PNF (west to east): Blue Mtns. Volcanic Arc (BVA); Weiser Embayment of Columbia River Basalt Province (CRB); Suture Zone in Volcanic arc (SZVA); Suture Zone in Idaho Batholith (SZIB); Idaho Batholith (IB); Precambrian metasedimentary province (Yms); Ordovician (?) to Tertiary (?) intrusions (OTi); Challis Volcanic Field (CVF); Tertiary intrusions (Ti).

Columbia River Basalt Province

Miocene flood basalts of the Columbia River Basalt Province cover much of central and eastern Washington and Oregon, northeastern California, northwestern Nevada, and west-central Idaho. The *Weiser Embayment* of the Columbia River Basalt Province, lies in the western part of the PNF, where basalt flows cover much of the Blue Mountains Volcanic-arc Accreted Terrane. Thickness of the basalt cover is variable, because the basalts are thicker in Miocene valleys than on Miocene hills, and because post-basalt erosion has removed more from post-Miocene valleys than from post-Miocene hills. Basalt flows locally are interlayered with fluvial and lacustrine sediments of the Payette Formation and (or) overlain by fluvial and lacustrine sediments of the Idaho Formation.

The Salmon and Snake Rivers flow in deeply incised canyons that cut through and well below the Miocene basalt flows. This indicates over 6,000 ft of riverine down-cutting in response to regional, post-Miocene uplift.

Basin and Range Province

The Basin and Range Province is a broad region, centered in Nevada, and characterized by north-trending structural valleys (grabens) between fault-bounded mountain ranges (horsts). Most of the Basin and Range Province lies south of the Snake River Plain, but northwest-trending horsts and grabens extend northward into Idaho north of the Snake River Plain.

Long Valley and the valleys of New Meadows, Bergdorf, Secesh Meadows and Warren Meadows are structural valleys within a region of broad post-Miocene uplift and erosion on the northern margin of the Basin and Range Province. They are grabens or half-grabens that contain tilted sedimentary strata of Miocene age, and (or) locally derived sediments of post-Miocene age. They are interpreted as incipient basins of the northward-propagating Basin and Range Province.

Pleistocene Features

Pleistocene valley glaciers have carved U-shaped valleys with over-steepened, talus-covered sides, and hanging tributaries with cirques and tarns in their upper reaches. U-shaped valleys also have lateral, terminal and recessional moraines, moraine-dammed lakes, and glacial outwash deposits at their lower ends. Broadly glaciated areas have rounded hills with glacially scraped and scoured up-glacier slopes, ground-moraine covered down-glacier slopes. Early Pleistocene moraines contain thoroughly decomposed boulders, whereas boulders in Middle Pleistocene moraines have weathered rinds, and boulders of Late Pleistocene moraines are relatively unweathered.

MINERAL DEPOSIT TYPES

A mineral deposit type represents a set of similar mineral deposits. Mineral deposit types of the PNF are herein named to indicate their principal commodities, and their predominant structural forms (layers, veins, stockworks of veinlets, disseminations, pipes, placers, etc.). Table 1 lists mineral deposit types of the western PNF, and table 2 lists those of the eastern PNF. USGS model names and numbers are given for those deposit types that correspond to USGS descriptive and (or) grade-tonnage models. In tables 1 and 2 mineral deposit types (and models) are organized by deposit environments, as in the classification scheme presented in USGS Bulletin 1693 (Cox and Singer, 1986). This arrangement focuses on features that can be recognized on (or inferred from) geologic maps, such as host-rock lithology and tectonic setting.

Table 1. Types of mineral deposits in the western PNF

Deposit Type	USGS Model Name	USGS model no.	Significant Endowment[1]	Deposit Code	Number of Occurrences[2]		
				dc	dc1	dc2	dc3
Types of Locatable Mineral Deposits of the Western PNF							
Deposits related to submarine metavolcanic rocks (of intermediate to felsic compositions)							
Kuroko Zinc-copper massive sulfide	Kuroko massive sulfide, and Sierran kuroko deposits	28a and 28a.1	yes	017	6		
Polymetallic Layers and Veins (stratabound, volcanic-related)	no USGS model		yes	009	19		
Deposits in clastic metasedimentary rocks							
Barite Layers and Veins	no USGS model -- different from either Bedded barite or Vein barite models	31b and 27e	no	012	4		
Manganese Layers and Veins	Franciscan type volcanogenic manganese	34b	no	011	6		
Deposits related to subaerial meta-volcanic rocks (of intermediate to felsic compositions)							
Disseminated Copper-silver (volcanic redbed copper-silver)	no USGS model -- GSC model: volcanic redbed copper		maybe	016	14	10	
Deposits related to regionally metamorphosed greenstones							
Copper-silver Polymetallic Veins	no USGS model		no	010	23		
Low-sulfide Gold-quartz Veins	Low-sulfide Au-quartz veins	36a	maybe	007	8		
Deposits related to porphyritic intrusions (of dioritic to granodioritic compositions)							
Iron Skarn	Fe skarn	18d	no	015	9		
Copper Skarn	Cu skarn	18a	yes	014	27	2	1
Porphyry Copper-molybdenum	Porphyry Cu-Mo	21a	no	013	6		
Deposits related to mafic intrusions and (or) ultramafic diatremes							
Magmatic Iron-Copper	no USGS model		no	038	2		
Diamond Pipes	Diamond pipes, Diamond-bearing kimberlite	12	no	049			
Types of Salable Mineral Deposits of the Western PNF							
Deposits of chemical sedimentary rocks							
Gypsum and Anhydrite	no USGS model -- different from either Bedded gypsum: Deposit subtype: Marine evaporite gypsum; or lacustrine gypsum models	35ae	no	023	2		
Deposits related to felsic intrusive rocks (mostly phanerocrystalline)							
Quartz -- Pegmatite, Vein	no USGS model		no	021	5		
Mica -- Pegmatite	no USGS model		no	022	6		
Deposits of mafic volcanic rocks							
Basalt for crushed stone	no USGS model		maybe				

1. See tables ST-1, ST-2, and section on Significant Deposits. 2. Localities with multiple deposit types are assigned multiple deposit codes in order of decreasing economic potential (dc1, dc2, dc3).

Table 2. Types of mineral deposits in the eastern PNF

Deposit Type	USGS Model Name	USGS model no.	Significant Endowment[1]	Deposit Code	Number of Occurrences[2]		
				dc	dc1	dc2	dc3
Types of Locatable Mineral Deposits of the Eastern PNF							
Deposits related to felsic intrusive rocks (mostly phanerocrystalline)							
Copper-gold Mixed-metal Veins	Mixed base- and precious-metal veins of the Idaho Batholith: Cu veins coproduct Au, and byproduct Ag, Pb, and (or) Zn	OF 94-690	yes	033	71	2	
Gold-silver Mixed-metal Veins (Au-Ag ± Cu,Pb,Zn,Sb,W)	Mixed base- and precious-metal veins of the Idaho Batholith: Au veins with byproduct Ag, Cu, Pb, and (or) Zn	OF-94-690	yes	001	148	2	
Distal Disseminated Gold-silver	Distal Disseminated Ag-Au	19c, and Theodore (in press)	yes	002	20	16	4
Antimony Veins	Simple Sb deposits	27d	no	003	7	5	
Disseminated Antimony	Disseminated Sb deposits	27e	yes	031	1	3	2
Tungsten Veins -- Quartz-huebnerite	W veins	15a	no	005	4	2	1
Tungsten Veins -- Quartz-scheelite	W veins	15a	yes	004	6	5	2
Mixed-metal Skarn and Hornfels	may include as components:						
	Cu skarn	18a	no	014	27	2	1
	Zn-Pb skarn	18c	no	032		3	
	Fe skarn	18d	no	015	9		
	Gold-bearing skarns	Bull. 1930	no	030		6	
	W skarn	14a	no	027	4	2	
Deposits related to subaerial felsic to mafic volcanic rocks							
Hot-spring Gold-silver	Hot-spring Au-Ag	25a	yes	018	80		
Hot-spring Mercury	Hot-spring Hg	27a	no	019	11		
Minor miscellaneous and unclassified deposits							
Rare-earth Lode			no	029	2		
Opal			no	020	5		
Quartz-fluorite Veins	Fluorite veins	26b	no	035	2		
Barite veins	Vein barite	27e	no	012	1		
Copper-silver-gold Pegmatite			no	034	4		
Uranium lode, undivided			no	046	2		
Unclassified			no	044	10		
Deposits related to surficial processes and unconformities							
Gold Placer	Placer Au-PGE, and Gold placer deposits	39a, and OF 85-213	yes	024	131	2	
Black-sand Placer			maybe	025	3	100	
Rare-earth Placer			maybe	026	5	3	24
Gem Placer			no	047			1
Types of Leasable Mineral Deposits of the Eastern PNF							
Fossil Fuels							
Coal (lignite)			no				
Types of Salable Mineral Deposits of the Eastern PNF							
Deposits related to felsic intrusive rocks (mostly phanerocrystalline)							
Quartz -- Pegmatite, Vein			no	021	5		
Deposits related to surficial processes and unconformities							
Sand and gravel			maybe				

1. See tables ST-1 and ST-2, and section on Significant Deposits. 2. Localities with multiple deposit types are assigned multiple deposit codes in order of decreasing economic potential (dc1, dc2, dc3).

This report is necessarily organized around mineral deposit types, because delineation of permissive and favorable tracts, and estimation of undiscovered resources must be done on the basis of deposit types as represented in descriptive and grade-tonnage models. Those deposit types that are known to be present, or considered likely to be present in the PNF, are described and discussed in the following sequence: 1. Locatable lodes present in accreted terranes of the western PNF, in order of oldest to youngest mineral deposit types, 2. Locatable lodes in the suture zone of the central PNF, 3. Locatable lodes present in the continental province of the eastern PNF, in order of oldest to youngest mineral deposit types, 4. Locatable placers, 5. Leasable mineral resources, 6. Salable minerals and mineral materials.

The description of each mineral deposit type includes all or some of the following: 1. Name of the mineral deposit type, and an arbitrary numerical code (assigned for the purpose sorting by deposit type), 2. Citation of USGS model name and number, 3. Description of salient characteristics shared by examples of that deposit type, 4. Interpretation of origin of deposits of that type, 5. Map showing locations of examples of that deposit type in the PNF, 6. Map showing tracts considered geologically permissive and (or) favorable for the presence of deposits of that type, 7. Description of the rationale for tract delineation, 8. Probabilistic estimate of potential mineral resources (if an appropriate USGS tonnage-grade model is available for the deposit type), 9. Consideration of the likelihood and potential character of future development, and 10. Description of environmental effects of past development, and implications for future development.

Localities with Multiple Mineral-Deposit Types

Some localities have characteristics of multiple mineral-deposit types, and some have ambiguous characteristics, indicative of alternative deposit types. Where multiple deposit types are present, or alternative deposit-type classifications are possible, multiple deposit codes are assigned. Each component type or alternative type is assigned its own deposit code (dc), and the deposit codes are ranked (dc1, dc2, dc3).

At localities with multiple mineral-deposit types, deposit-code ranking is in order of decreasing perceived economic value and potential. For example, at Stibnite, underground mining of the Meadow Creek gold-silver mixed-metal vein led to discovery of multiple deposit types mined from the nearby Yellow Pine Pit, including first-rank distal disseminated gold-silver deposits (dc1=002), second-rank tungsten veins (dc2=004), and third-rank disseminated antimony deposits (dc3=031). Similarly, most gold placers also contain black sands, and some contain rare-earth minerals. Although black sands are more abundant than the gold, the gold has more economic importance, so it is the first-rank component (dc1=024). Black sand commonly is the second-rank component (dc2=025), and the less abundant rare-earth component commonly is the third-rank component (dc3=026)

At localities with alternative deposit types, the favored deposit-type classification generally is listed first. However, in a few cases a preliminary deposit code is followed by a preferred alternative deposit code, added later. For example, the Imperial gold-silver vein prospect was first classified as a gold-silver mixed-metal vein (dc1=001) on the basis of its commodities and form. However, gold-silver mixed-metal veins are related to Late Cretaceous two-mica granite of the Idaho Batholith, whereas the Imperial vein is in the Eocene syenogranite stock of Chamberlain Basin. An alternative deposit type, silver-gold polymetallic veins related to Tertiary intrusions (deposit code 050), was defined and assigned to the Imperial prospect as (dc2=050). Other similar cases are explained in the text.

Past Production and Identified Resources

Of over 600 mines present in the PNF and vicinity, 185 are past producers of commodities such as gold, silver, copper, lead, zinc, iron, manganese, tungsten, antimony, mercury, fluorite, mica, quartz, barite, gypsum and anhydrite, sand-and-gravel, and stone for crushed-rock. The US Bureau of Mines recently summarized recorded past production for mines of the PNF (USBM, 1996). Identified resources and known reserves of mineral deposits of the PNF have been summarized recently by the U.S. Bureau of Mines (USBM, 1996).

Significant Deposits

Significant deposits are defined as those that contain as much or more than 2 tonnes of gold; 85 tonnes of silver; 30,000 tonnes of lead; 50,000 tonnes of zinc; or 50,000 tonnes of copper (Donald A. Singer, written commun., 1992; Singer, 1995). Over 99 percent of total discovered world production and resources of gold, silver, lead, zinc, and copper are from (or in) deposits that contain as much or more metal than those minimum tonnages. For other metals not listed above, deposits of one million tonnes of ore are, until world-wide statistics are compiled, considered as significant deposits (Donald A. Singer, written commun., 1992).

As shown in table 3, five areas in the PNF and vicinity have significant past production and (or) identified resources: (1) the *Warren* mining district has significant past production of gold from gold placers and gold-silver mixed-metal veins; (2) the *Stibnite* subdistrict of the Yellow Pine mining district has significant past production and identified resources of gold in distal disseminated gold-silver deposits; (3) the *Thunder Mountain* mining district has significant past production and identified resources of gold in hot-spring gold-silver deposits; (4) the *Red Ledge* prospects have significant resources of zinc, copper, silver, and gold in Kuroko massive sulfides and feeder veins, veinlets and disseminations; and (5) the *Hercules* deposit, which is lies just west of the PNF, has significant identified resources of silver in volcanic-related, stratabound polymetallic layers, veins, and disseminations.

Table 3. Significant mineral deposits and mining districts of PNF and vicinity: Production and resources

		Production (tonnes)				Resources (tonnes)						
Deposit	**Deposit Type**	**Au**	**Ag**	**Sb**	**WO_3**	**Au oxide ore**	**Au sulfide ore**	**Ag**	**Zn**	**Cu**	**Comments**	**References**
Warren district placers and veins	Gold placers	24.4	20.7									Reed, 1937
	Gold-silver mixed-metal veins	2.92	1.8									Reed, 1937; Bliss 1994
Stibnite sub-district (*1), Yellow Pine mining district	Distal Disseminated Au-Ag, Sb, W, and Au-Ag mixed-metal veins	17.1	52.5	34,300	7,850	15.3	58.4				oxide R @ 1.3 to 1.8 ppm Au; sulfide R @ 2.1 to 3.1 ppm Au	Cookro and others,1988; Randol, 1992,1994, 1996; USBM 1996
Thunder Mtn. mining district, Sunnyside, Dewey mines (*2)	Hot-springs Gold-silver	3.67	4.78			12					R @ 1.5 ppm Au	USMX (1997)
Red Ledge prospects	Kuroko massive sulfide layers					5		485	174,000	54,000	R @ 2.9% Zn, 0.9% Cu, 80.8 ppm Ag, 0.9 ppm Au.	Fifarek and others, 1994
	Kuroko feeder veins, veinlets, disseminations					15.5		716	198,000	99,000	R @ 0.6% Zn, 0.3% Cu, 21.7 ppm Ag, 0.47 ppm Au.	Fifarek and others, 1994
Hercules prospect (700 m west of PNF)	Polymetallic layers and veins							577	20,400		R @142 ppm Ag, 0.5 % Zn.	American Mines Handbook, 1994; Earl Bennett, pers. comm., 1995
	Total	48.1	79.8	34,300	7,850	47.8	58.4	1,780	392,000	153,000		

1. See Table 8 for production and resources of individual mines of the Stibnite mining area.
2. See Table 12 for production and resources of individual mines of the Thunder Mtn. mining district.

Location and Classification of PNF Mineral Localities

Plate 1 includes a list of mineral localities of the PNF and vicinity (sorted alphabetically by name, and numbered accordingly), and a map that shows the location of each numbered mineral locality. Appendix A is an alphabetical list of mineral localities with locations given by latitude-longitude, commodities listed by chemical symbol and (or) mineral name. Appendix A also gives deposit codes (dc1, dc2, dc3), and references for each mineral locality. Appendix B is a list of mineral localities, sorted by deposit type codes (first by dc1, second by dc2, and third by dc3). It also gives locations by mining district, lists commodities and ore minerals, and briefly describes the form of each deposit (vein, skarn, placer, etc.).

Number of Occurrences of each Mineral Deposit Type

Tables 1 and 2 list the number of occurrences of each deposit type present in the PNF and vicinity, at each of three component ranks (dc1, dc2, and dc3). The ten deposit types ranked as dc1 components most frequently in the PNF and vicinity are: 1. Gold-silver mixed-metal veins (148), 2. Gold placers (131), 3. Hot-spring gold-silver deposits (80), 4. Copper-gold mixed-metal veins (71), 5. Copper skarns (27), 6. Copper-silver polymetallic veins (23), 7. Distal-disseminated gold-silver deposits (23), 8. Polymetallic layers and veins (19), 9. Disseminated copper-silver deposits (14), and 10. Hot-spring mercury deposits (11).

Mineral Deposit Types with Significant Mineral Endowments

Mineral endowment is the total of past production, identified resources, and estimated potential resources. Mineral endowment of a deposit type is considered significant if it is equal to or greater than the amount contained in the smallest deposits of those from which over 99 percent of world production is obtained (See the definition of significant deposits, by commodity, in the Significant Deposits section of this text.).

In and around the western PNF, the total mineral endowments of the following deposit types are considered significant: Kuroko massive sulfide, Polymetallic layers and veins, and Copper skarns. Low-sulfide gold-quartz veins may also be considered to contain significant mineral endowments if the mean is used as the preferred measure of central tendency of the probabilistic estimate of potential mineral resources (See tables S-1 and 1). Basalt for crushed stone is abundant and widely distributed in the western PNF.

In and around the eastern PNF, the total mineral endowments of the following deposit types are considered to be significant: Gold-silver mixed-metal veins, Distal disseminated gold-silver, Antimony veins, Tungsten veins -- Quartz-scheelite, Hot-spring gold-silver, and Gold placer deposits (See tables S-2 and 2). Mineral endowments of Black-sand placers, Rare-earth placers, may also be significant, but economic demand and quantitative data are lacking. Sand-and-gravel deposits are common and widely distributed in the eastern PNF.

Table 4. Mineral locality discoveries, by deposit type and decade*

	Decades													
Deposit Types	1860s	1870s	1880s	1890s	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s
Gold placer	2			1	1					1	1			
Gold-silver mixed-metal veins	1	3	1	4	6	2	3	4	3	2	1		1	3
Quartz-fluorite veins	1													
Polymetallic layers, veins, and disseminations		2		2									1	
Copper skarn		1	5	3							1			
Copper-silver polymetallic veins and (or) disseminated copper-silver deposits			1	1										
Copper-gold mixed-metal veins			1	2	19	2	4	6	2	1	2			
Iron skarn				5										
Kuroko copper-zinc massive sulfide				2							1	1		
Hot-spring gold-silver				2	8	1					1		2	1
Low-sulfide gold-quartz veins				1										
Hot-spring mercury					2				1					
Opal					1						1			
Mica - pegmatite					1				3					
Distal disseminated gold-silver							2	1	1	1	1		3	5
Porphyry copper-molybdenum							1				1	1		
Disseminated antimony and Antimony veins							1				1			
Tungsten veins									2	2	1			
Barite layers and veins									1					
Quartz - pegmatite									1					
Copper-silver-gold pegmatite										1				
REE lode											1			

* Discovery dates for 135 mineral localities are from 634 MRDS records. Others are from literature cited in descriptions of deposit types.

Discoveries by Deposit Type and Decade

Table 4 lists the number of mineral-locality discoveries reported by decade for many types of mineral deposits present in the PNF and vicinity. These data are from 634 MRDS records, 135 (or 20 percent) of which contain discovery dates. Also included are selected discovery dates from literature cited in descriptions of deposit types in this report. Many recent discoveries probably represent re-discoveries of localities that were originally for one deposit type, then later claimed for another. For example, some localities that were originally claimed as veins have been explored later for bulk-mineable disseminated deposits. Although these data are incomplete, the following salient events and exploration trends can be recognized by inspection of Table 4.

Initial discoveries in the 1860s were of gold placers, gold-silver mixed-metal veins, and quartz-fluorite veins. Placer gold discoveries were reported in three episodes, first in the 1860s, second in the 1890s to 1900s, and third in the 1950s to 1960s. Discovery rates for gold-silver mixed-metal veins peaked in the 1900s, but new discoveries have been reported in most decades since the 1860s.

Long after initial discoveries in the 1890s, copper-zinc deposits of the Seven Devils area were further explored in the 1960s and 1970s, and some were recognized as Kuroko massive sulfides by the 1980s. Long after initial discoveries of polymetallic layers and veins in the 1870s, such deposits were further explored in the 1970s and 1980s, and were then recognized as volcanic-related, stratabound veins, disseminations and massive sulfides.

Discoveries of copper and iron skarns peaked in the 1880s and 1890s. Discoveries of copper-gold mixed-metal veins peaked in the 1900s, but continued into the 1960s (after which the area in which they are present was scheduled for inclusion in the Frank Church - River of No Return Wilderness area). Discoveries of hot-springs mercury deposits peaked during the 1900s but recurred during the 1940s in response to WW II. Discoveries of quartz and mica deposits also peaked during the 1940s, in response to the war. Discoveries of tungsten veins were made during the 1940s to 1950s, in response to both World War II and the Korean War.

During the 1960s, one or two discoveries were recorded for each of many types of deposits, but in the 1970s only Kuroko copper-zinc, and porphyry copper-molybdenum discoveries were reported.

Recent exploration activity (in the 1980s and 1990s) has been mostly for precious-metals lodes. Small-sized mining companies discovered and (or) re-discovered gold-silver mixed-metal veins, while medium- to large-sized companies discovered, explored, and developed relatively large, low-grade, bulk-mineable gold deposits. Discoveries of distal disseminated gold-silver deposits, which began in the 1920s, peaked in the 1980s and 1990s. Discoveries of hot-spring gold-silver deposits, which first peaked in the 1900s, were renewed in the 1980s and 1990s.

LOCATABLE MINERAL RESOURCES, WESTERN PNF

Locatable mineral resources are minerals and mineral materials that can be acquired by discovery, and the staking and patenting of claims under the United States Mining Law of 1872. In general, locatable minerals are "whatever is recognized as a valuable mineral by standard authorities, whether metallic or other substance, when found on public land open to mineral entry, in quality and quantity sufficient to render a claim valuable on account of the mineral content" (USFS, 1983). However, certain leasable and salable minerals specifically are excluded from acquisition by location (See Leasable Mineral Resources and Salable Mineral Resources, this report).

Mineral Deposits in Accreted Oceanic Terranes

In the western PNF, metavolcanic and metasedimentary rocks of the Blue Mountains Oceanic Island Arc (of Permian to Jurassic age) crop out where overlying Columbia River basalt has been removed by erosion. The metavolcanic rocks are mostly greenschist, green phyllite and greenstone, derived from volcanic and volcaniclastic rocks of intermediate to felsic composition. Layers and lenses of metasedimentary conglomerate, limestone and gypsum are locally interlayered with the metavolcanic rocks. Igneous intrusions of dioritic to granodioritic composition also are present.

Syngenetic, Volcanic-Related Deposits

Manganese layers and veins, Kuroko zinc-copper massive sulfides, barite layers and veins, and volcanic-related polymetallic deposits are interpreted as syngenetic deposits that formed during deposition of volcanic and sedimentary strata of the Blue Mountains Island Arc.

Manganese Layers and Veins (Volcanogenic)
deposit code 011

USGS model -- Franciscan-type volcanogenic manganese deposits

USGS descriptive and grade-tonnage models were made by Mosier and Page (1988) for four types of submarine volcanogenic manganese deposits. Franciscan-type deposits are associated with chert, shale, and graywacke around the margins of submarine mafic volcanic centers.

Description -- Mn-bearing siliceous layers and stratabound quartz-Mn veins

Mn-bearing siliceous layers and stratabound quartz-Mn veins within and in and near the western PNF are hosted in siliceous metasedimentary rocks of the accreted Blue Mountains oceanic island-arc. They are classified as Franciscan-type volcanogenic manganese deposits, which commonly consist of manganese oxides and silicates, hosted in chert ± shale partings, associated with mafic volcanic rocks, tuff, serpentine, and graywacke.

Interpretation -- submarine volcanic-exhalative Mn-bearing chert

Mn-bearing siliceous layers in and near the western PNF are interpreted as Franciscan-type manganiferous volcanic-exhalative chert deposits. Such deposits probably form around the margins of mafic volcanic centers, in oceanic-ridge and backarc-basin environments. Associated quartz-manganese veins and breccia fillings may represent volcanic-exhalative feeder zones. These have undergone various degrees of metamorphism to manganiferous jasperoidal silica, quartzitic schist, and (or) quartz-garnet rock.

Examples

Brownlee and Sturgill prospects: Four manganese-oxide mines and prospects are present in the vicinity of Brownlee and Sturgill Creeks, just west of the southwest boundary of the PNF. At the Brownlee prospect, manganese oxides are associated with quartz in metasedimentary gray sericitic phyllite (Cook, 1954). At the Sturgill prospect manganese oxides are present in stratiform jasperoidal silica (metachert), and stratabound zones of veins and quartz breccia in quartzitic schist. Statiform manganese zones are as wide as 15 ft (4.5 m), and contain 2 to 20 weight percent of manganese (Livingston, 1919; Cook, 1954; Prinz, 1964).

Metasedimentary rocks of the area are quartzite, schist, slate, and some marble of the Baker terrane, "a disordered assemblage of Paleozoic and Triassic meta-igneous and metasedimentary rocks incorporated in serpentine-matrix melange" (Bishop, 1995). The mineralogy and geochemistry of mafic igneous rocks of the Baker terrane indicate formation in a variety of tectonic settings, including mid-ocean ridge, island arc, and rift or transform settings. Products of these settings were later subducted and sheared in a fore-arc setting.

Burntrock and New Meadows prospects: The Burntrock Mn prospect lies within the PNF, in the West Mountains, southwest of New Meadows (fig. 6). The New Meadows manganese prospect is about 4 km north of the Burntrock prospect, and is outside the PNF. These manganese prospects are hosted in undivided biotite ± hornblende gneiss and schist, which are interpreted as metasedimentary and metavolcanic rocks of the eastern part of the Blue Mountains oceanic island-arc accreted terrane, which was strongly metamorphosed and deformed during Cretaceous time (Lund, unpub. data, 1997). At the Burntrock prospect, "manganese oxides occur in a 5 ft thick lens in a tabular zone of quartz-garnet rock in altered biotite schist" (USBM, 1996). The manganese-bearing quartz-garnet rock of the Burntrock prospect is interpreted as metamorphosed exhalative chert.

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is considered permissive for manganese layers and veins, except where it is contains igneous intrusions, or is buried by Miocene basalt more than 1 km thick.

Favorable tracts for manganese layers and veins include exposures of undivided gneiss and schist of the Blue Mountains Island Arc, and metasedimentary rocks of the Baker terrane (fig 6). These units contain known manganese layers and veins.

Reason for no Numerical Estimation

No numerical estimation was made for potential resources of Franciscan-type manganese deposits in the western PNF, because the known deposits are too low-grade to fit the grade-tonnage model. Franciscan-type manganese deposits have a median tonnage of 450 tonnes, and a median grade of 36 weight percent Mn, with less than 5.1 percent Fe (Mosier and Page, 1988). Eighty percent of manganese deposits in the tonnage-grade model for Franciscan-type manganese deposits have Mn contents higher than 25 weight percent, whereas the Sturgill Creek manganese deposits contain only 2 to 20 weight percent Mn. The known manganese deposits of the PNF and vicinity are therefore too low-grade to be well represented by the grade model for Franciscan-type manganese deposits.

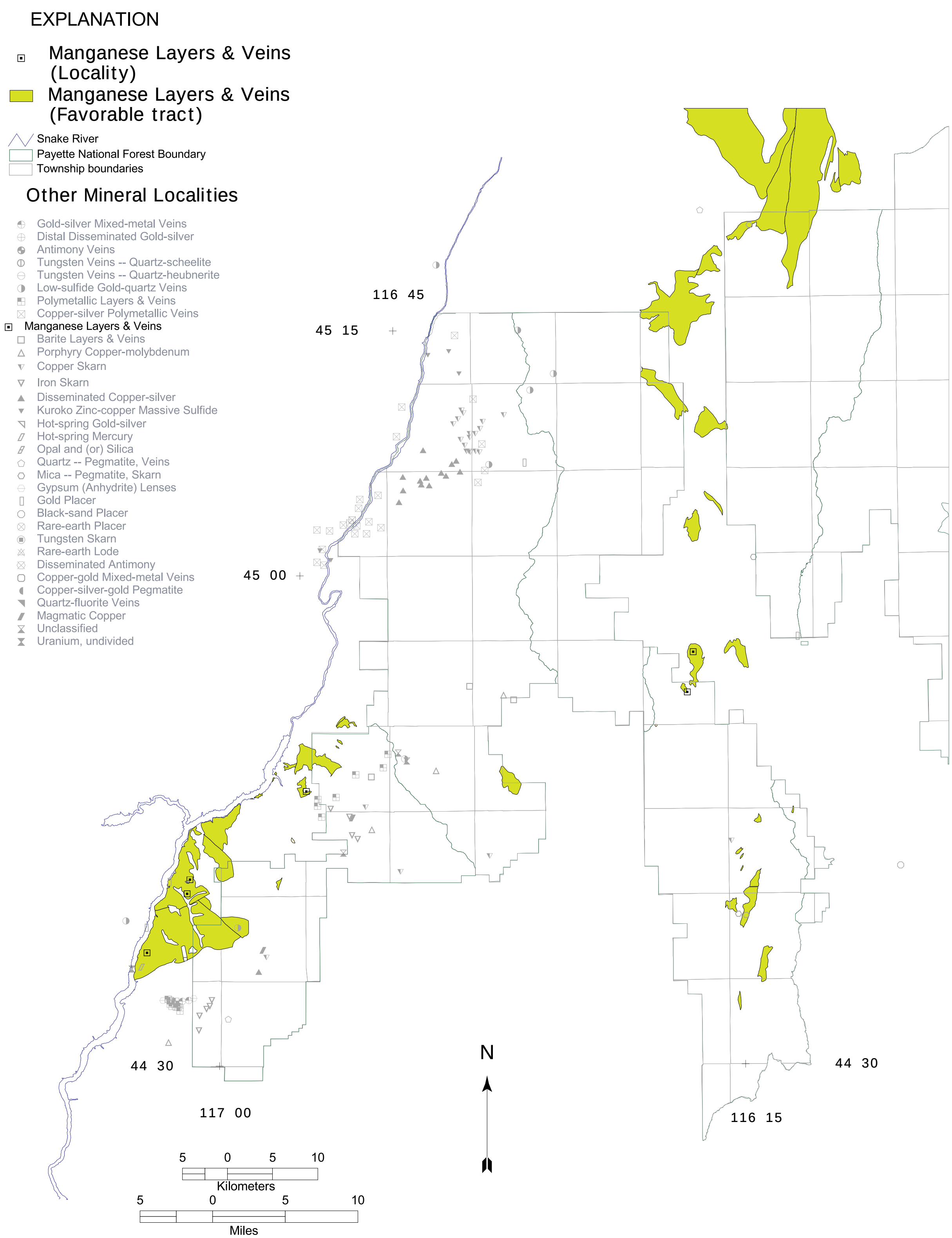


Figure 6. Map showing localities and favorable tracts for Manganese Layers and Veins, western PNF.

Development Forecast

World resources of manganese are very large in relation to world consumption, but the United States has virtually no reserves, and its known resources are very small, low-grade, and(or) difficult to concentrate economically (Dorr and others, 1973). Manganese ore was last mined from the Sturgill deposits for sale to the Government stockpile in the mid-1950s. Assuming that world metals trade remains relatively open, there is little likelihood that the small manganese deposits in and around the PNF will be actively explored or developed in the foreseeable future.

Environmental Effects and Implications

Manganese oxides have low solubility and normally do not represent an environmental concern, but manganese-enriched dust may pose health risks (Mosier and Campell, 1995). Inasmuch as development of manganese resources is unlikely in PNF, environmental effects probably will be minimal.

Kuroko Zinc-copper Massive Sulfides (volcanogenic)

deposit code 017

USGS models -- Kuroko massive sulfide, Sierran Kuroko massive sulfide, Volcanic-associated massive sulfide

USGS descriptive and grade-tonnage models for Kuroko massive sulfide deposits (model 28a) were made by Singer (1986) and Singer and Mosier (1986). Sierran Kuroko massive sulfide deposits are a subset of relatively small deposits, typical of accreted terranes in California, British Columbia, and Alaska. A USGS tonnage-grade model for Sierran Kuroko massive sulfides (model 28a.1) was made by Singer (1992b). A USGS geoenvironmental mineral deposit model for volcanic-associated massive sulfide deposits, including Kuroko massive sulfides, was written by Taylor and others (1995).

Description -- Zn-Cu-Fe ± Au-Ag in layered massive sulfides, with associated veins and disseminations

Kuroko massive sulfide deposits are layers and lenses of iron- zinc- and copper-bearing sulfide minerals, associated with marine volcanic rocks of intermediate to felsic composition (Singer, 1986). Submassive to massive accumulations of sulfide minerals that comprise Kuroko massive sulfides deposits tend to be finely layered. The layered massive sulfides commonly are underlain by stockworks of copper-bearing veins, veinlets, and disseminations. Kuroko-type deposits tend to have well-developed geochemical zonation. From a central zone that is enriched in copper and iron, composition grades progressively upward and outward through zones that are relatively enriched in iron and zinc, zinc and lead, precious metals, and barite (Taylor and others, 1995). In accreted terranes, Kuroko massive sulfides and their host rocks commonly have been deformed (tilted or folded), and dynamothermally metamorphosed.

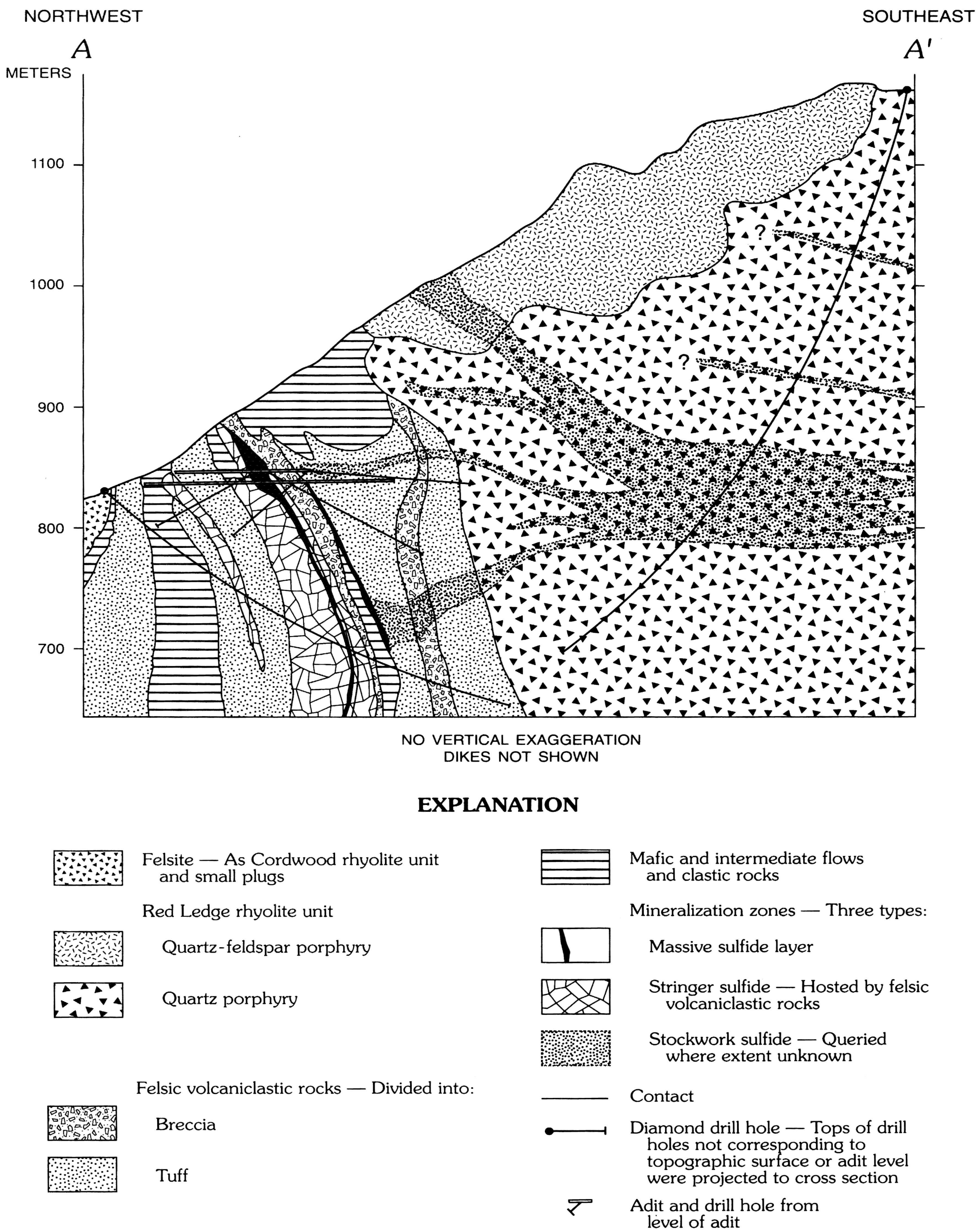


Figure 7. Cross section showing geology and Kuroko massive sulfide deposits of the Red Ledge Cu-Zn prospect. (Fifarek and others, 1994, p. 119).

Interpretation -- submarine volcanic-exhalative layers of massive sulfides, with feeder veins and replacement disseminations

Kuroko massive sulfides are interpreted as volcanogenic submarine exhalative deposits that formed by sea-floor venting of hot, metal-bearing fluids, associated with volcanism of intermediate to felsic composition, in oceanic island-arc environments. Underlying stockworks of veins and veinlets are interpreted as mineralized fractures in hot-spring feeder zones. Disseminated sulfides probably formed by replacement of permeable volcaniclastic sediments.

Examples

Appendix B lists 6 examples of Kuroko massive sulfide deposits, 5 of which lie inside the PNF. Three well-studied examples are described below.

Red Ledge prospect: The Red Ledge deposit lies in the Hells Canyon - Seven Devils Scenic Area. It is the most significant known Kuroko massive sulfide deposit in the Payette National Forest. It has been explored by small adits and core drilling, but has no recorded production. According to Fifarek and others (1994), the Red Ledge deposit consists of three to four stacked sets of steeply dipping, stratiform massive sulfide layers and strata-bound stringers, which stratigraphically overlie a discordant zone of stockwork sulfide veinlets, hosted in a rhyolite-porphyry dome complex (fig. 7). Layers of massive sulfide typically grade from granular pyrite-quartz-chalcopyrite to laminated sphalerite-pyrite-barite ± galena with increasing distance from the underlying stockwork zone. Stringer sulfides in-fill and partially replace beds of felsic breccia. Mineralized breccia is interlayered with hematite-barite exhalite, chloritic tuffaceous exhalite, altered lava flows, and sandstone (Fifarek and others, 1994). Silicified rocks host the stringer and stockwork sulfides.

Fifarek and others (1994) estimated that massive sulfide bodies of the Red Ledge deposit total about 6 million tonnes of ore, averaging 2.9 percent zinc, 0.9 percent copper , 0.9 g gold/tonne, and 80.0 g silver/tonne. In addition, Fifarek and others (1994) estimated that stringer sulfide bodies of the Red Ledge deposit comprise about 33 million tonnes at average grades of 0.6 percent zinc, 0.3 percent copper, 21.7 g silver/tonne, and 0.47 g gold/tonne.

Iron Dyke mine: The Iron Dyke copper-silver-gold mine lies on the west side of the Snake River, near Oxbow, Oregon. It consists of fragments of Kuroko massive sulfide, hosted in volcanic mudflow conglomerate (lahar), composed of felsic volcanic debris (Bussey and LeAnderson, 1994). Although the Iron Dyke deposit is just west of the PNF, its presence indicates that the volcanic part of the Wallowa terrane contains Kuroko-type deposits outside the Red Ledge area.

Hornet Creek prospect: The Hornet Creek copper-gold-silver prospect is in the Hornet Creek mining district, near North Hornet Creek, and northeast of Peck Mountain. There, felsic metavolcanic rocks of the Triassic Huntington Formation of the Izee Terrane contain stratiform layers and lenses (1- to 5-m thick) of semi-massive to massive pyrite ± chalcopyrite, magnetite, silica, and barite. Massive pyrite ± chalcopyrite locally contains 3 ppm gold, 3 ppm silver, 1,600 ppm copper, minor molybdenum, and 1.2 percent barium (Mangham, 1994). These deposits have been interpreted as epigenetic replacements and disseminations. However, Mangham (1994) presented convincing evidence that they are Kuroko-like deposits of syngenetic submarine exhalative origin.

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is considered permissive for Kuroko-type deposits, except where it contains igneous intrusions, or is buried by more than 1 km of Miocene basalt flows (Box and others, 1996, p. 117 to 125).

Favorable tracts for Kuroko massive sulfide deposits are limited to predominantly metavolcanic parts of the Blue Mountains Island-arc terrane that contain known massive-sulfide prospects, and (or) geochemical anomalies for copper, lead, and (or) barium (fig. 8). Known Kuroko massive sulfide prospects are present in the Wallowa and Olds Ferry Terranes. Stream-sediment geochemical anomalies for copper, barium, and lead are associated with predominantly metavolcanic rocks of the Wallowa, Olds Ferry, and Izee terranes (K.C. Watts and H.D.King, unpub. data, 1997; Karen Lund, unpub. data, 1997). Favorable tracts for Kuroko massive sulfide deposits include these terranes, except where they contain large igneous intrusions, and (or) where they are covered by Miocene basalt (fig. 8). The assessment tract includes all favorable tracts as subunits.

Rationale for Numerical Estimation

The Kuroko massive sulfide tonnage-grade model has a median tonnage of 1.5 million tonnes, and median metal grades of 2.0 wt percent Zn, 1.3 wt percent Cu, 13 g Au/tonne, and 0.16 g Au/tonne. A subset of smaller Sierran Kuroko massive sulfides (model 28a.1) have a median size of 310,000 tonnes, and median metal grades of 2.9 wt percent Zn, 1.4 wt percent Cu, 32 g Ag/tonne, and 1.3 g Au/tonne (Singer, 1992).

The 6-million-tonne Red Ledge Kuroko massive sulfide deposit is unusually large for such a deposit of Mesozoic age in accreted terranes of the western United States, where smaller deposits that fit the Sierran Kuroko model are more typical. Furthermore, the Red Ledge deposit appears to be much larger than the potential deposits represented by otherwise similar prospects in the PNF. The assessment team therefore chose to use the Sierran Kuroko model to represent the tonnage and grade of undiscovered Kuroko-like deposits in the PNF.

The following features indicate potential for undiscovered Sierran Kuroko-type deposits in the western part of PNF: (1) Kuroko-type mineral prospects (appendix B and Fig. 8); (2) geochemical stream-sediment anomalies for copper, silver, and barium; (3) aeromagnetic lows, interpreted to represent areas of hydrothermal destruction of magnetic minerals. Estimation of numbers of undiscovered deposits was done by counting targets, considering the favorability of their attributes, and subjectively estimating how many targets are likely to fit between the 10th and 90th percentiles of the tonnage and grade models for Sierran Kuroko massive sulfide deposits at various levels of subjective probability, as follows.

Estimation of Undiscovered Resources

For the 90th, 50th, 10th, 5th, and 1st percentiles of subjective probability, the assessment team estimated 0, 1, 2, 5, and 5 undiscovered deposits consistent with the grade and tonnage model for Sierran Kuroko massive sulfide deposits. This conveys the group opinion that there is good potential for 1 or 2, but not more than 5 undiscovered deposits that would fit between the 90th and 10th percentiles of the Sierran Kuroko model. Results of the Mark 3 estimation of undiscovered resources of metals and ore are summarized in table 5.

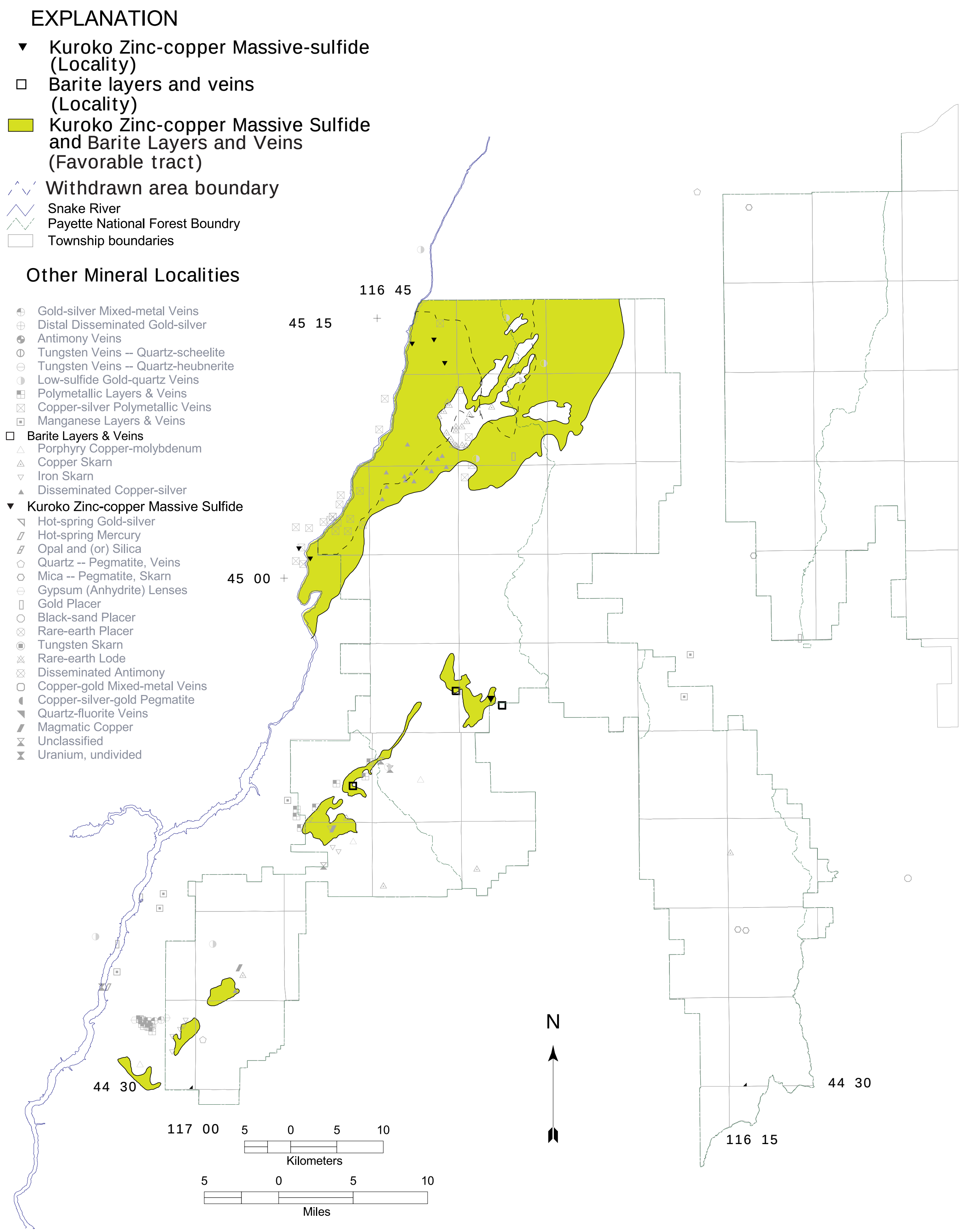


Figure 8. Map of localities and favorable tracts for Kuroko Copper-zinc Massive-sulfides, and for Barite Layers and Veins, western Payette NF.

Table 5. Sierran Kuroko Massive Sulfide: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Sierran Kuroko Massive Sulfide (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	1	2	5	5

Mark 3 output

Estimate of probability of 0 deposits: 29%

Estimate of probability of the median number of deposits (1): 40%

Estimate of mean expected number of deposits: 1.2

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Sierran Kuroko Massive Sulfide (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
copper	0	3,400	48,000	15,000	28%
zinc	0	2,600	88,000	32,000	18%
lead	0	0	16,000	7,100	15%
gold	0	0	6.5	1.9	21%
silver	0	3.9	240	100	16%
ore	0	210,000	2,600,000	840,000	28%

Development Forecast

For the next ten years, intermittent exploration for Kuroko-type deposits is expected in permissive tracts outside the Hells Canyon - Seven Devils Scenic Area. Demand for zinc, copper, silver, and gold may stimulate interest in exploration for and development of Kuroko-type deposits in the northwestern U.S. The zinc smelter at Trail, British Columbia, will need zinc ore to replace depleted reserves of the Sullivan deposit. However, much of the most-favorable area for discovery and development of Kuroko-type mineral resources lies within the Hells Canyon - Seven Devils Scenic Area, which is closed to mineral entry.

Environmental Effects and Implications

“Volcanic-associated massive sulfide deposits are among the most likely of all deposit types to have associated environmental problems, particularly acid mine drainage” (Taylor and others, 1995). Abundant pyrite and (or) pyrrhotite in massive sulfides have high potential for acid generation by weathering. Abundant base metals in massive sulfides are soluble in acidic waters. Sericitized felsic host rocks have low acid-buffering capacity, but surrounding regional greenstones have relatively high buffering capacity.

Mine-water sample ABRL-1 was collected from drainage from the portal of the lower exploration adit of the Red Ledge deposit. The sample was taken in September of 1994, after several holes had been drilled and grouted in an effort to seal fractures around the adit and minimize the flow of groundwater into the adit. The slow-flowing mine-drainage stream was about 2.5 ft (0.76 m) wide and 3 in (7.6 cm deep). The water was tea-colored, and the rocks on the stream bottom were thickly coated with orange-brown hydrous iron oxide. When the water sample was filtered, the white 0.2 micron filter turned orange, but the filter did not plug. The mine-water sample was acidic (pH 3.12), and the filtered sample had very high concentrations of dissolved sulfate (1,250 ppm), copper (11,000 ppb), zinc (7,600 ppb), and manganese (1,700 ppb); and the following concentrations of other elements: cadmium (120 ppb), iron (71 ppb), cobalt (64 ppb), lead (38 ppb), nickel (19 ppb), and arsenic (4 ppb).

Water sample ABRL-2, was collected from the rushing, cascading water of Deep Creek, about 200 ft (60 m) downstream from the lowest waste dumps below of the Red Ledge workings. The water was milky, and rocks of the stream bed were heavily coated with yellow-brown hydrous iron oxides. As compared to the mine-drainage water, the stream water had much higher pH (7.56) and much lower concentrations of sulfate (104 ppm), copper (40 ppb), zinc (150 ppb), manganese (22 ppb), cadmium (2 ppb), iron (0.09 ppb), cobalt (<2 ppb), lead (0.4 ppb) , nickel (<4 ppb), and arsenic (<2 ppb).

Natural weathering of the pyritic Red Ledge copper-zinc deposit tends to produce acidic, metal-rich groundwater in the unsaturated zone. As long as exploration and mine workings are small, and vadose groundwater flows are minor in comparison to local stream flows, the results of acid mine drainage will be local and relatively minor. However, large-scale mining tends to greatly increase rock breakage, permeability, and surface area available to interact with oxidizing vadose groundwater. Thus, acid mine drainage is a potentially serious environmental problem that would have to be addressed if Kuroko-type massive sulfide deposits were developed for large-scale mining in the PNF.

Barite Layers and Veins (volcanogenic)
deposit code 012

USGS models -- different from USGS models for bedded barite and vein barite

USGS descriptive and tonnage-grade models are available for bedded barite deposits, hosted in clastic sediments (model 31b, by Orris, 1986a,b). A revised descriptive model for Sedimentary exhalative barite (model 31b) was presented by Clark and Orris (1991). An updated grade-tonnage model of Bedded barite was made by Orris (1992a). However, these Bedded barite models are not appropriate for the Barite layers of the western PNF, which are relatively small volcanic-related deposits, rather than the much larger sedimentary exhalative bedded barite deposits described by the models.

USGS descriptive and tonnage-grade models are available for epigenetic Vein barite deposits (model 27e, descriptive model by Clark and Orris, 1991; tonnage-grade model by Orris, 1992b). However, the barite veins associated with volcanic-related bedded barite layers in the western PNF appear to be smaller than most of the barite veins described by the tonnage-grade model.

Description -- volcanic-hosted barite layers and veins

Barite layers of the western PNF are stratiform deposits of barium sulfate ± silica ± pyrite ± chalcopyrite ± magnetite ± gold, which are interlayered with felsic metavolcanic rocks. Associated barite veins and veinlets are structurally below the volcanic-hosted barite layers. They are oriented at high angles to the barite layers, and they branch upward toward the overlying barite layers (Mangham, 1994).

Interpretation -- submarine volcanic-exhalative barite layers and feeder veins

Volcanic-hosted Barite layers and veins of the western PNF are interpreted as products of volcanic-related submarine hot-spring systems, similar to those that formed Kuroko massive sulfides. Barite veins below barite layers are interpreted as submarine hot-spring feeder veins.

Examples

Three of the four examples of barite layers and veins listed in table 1 and appendix B are located in the Hornet Creek and Cuddy Mountain mining districts, and are hosted in metavolcanic rocks of the western PNF.

North Hornet mine and prospect area: The North Hornet barite mine is on the northeast slope of Peck Mountain, near the North Hornet copper-gold-silver prospect, both of which contain barite beds and veins. At both, massive barite is present in stratiform layers and lenses, and disseminated barite is common in altered rocks around them. Upward-branching barite feeder veins are present in rocks beneath the barite layers and disseminations (Mangham, 1994). Deposits of the North Hornet mine and prospect area are interpreted as syngenetic, volcanic-related submarine exhalative barite deposits, with associated pyritic massive sulfides.

Rational for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is permissive for barite layers and veins, except where it contains igneous intrusions or is buried under more than 1 km of basalt.

Favorable tracts for barite layers and veins are coincident with favorable tracts for Kuroko massive sulfides (fig. 8). Stream sediment geochemical anomalies for barium indicate that all of the rock units that are favorable for Kuroko massive sulfides also are favorable for barite occurrences (K.C. Watts and H.D. King, unpub. data, 1996). Known barite layers and veins are hosted in the Triassic Huntington Formation of the Olds Ferry terrane, and in undivided greenstones of the Seven Devils Group of the Permian-Triassic Wallowa terrane (Karen Lund, unpub. data, 1997).

Reason for no Numerical Estimation

Numerical estimates of undiscovered barite resources were not made, because appropriate tonnage-grade models are lacking. Sediment-hosted Bedded barite deposits modeled by Orris (1986a, b) are much larger than the volcanic-hosted barite deposits of the western PNF.

Development Forecast and Environmental Implications

It is unlikely that barite layers and veins of the western PNF will be developed for barite in the next ten years. They represent relatively insignificant resources that would be high-cost producers in a market where many larger, lower-cost producers are idle. Since development is unlikely, environmental impact probably will be negligible. Nevertheless, associated gold-bearing pyritic beds may attract gold exploration efforts.

Polymetallic Layers and Veins (volcanogenic)

deposit code 009

USGS model -- no USGS model -- Ag-Zn-Pb analogue of Kuroko massive-sulfide layers, and associated feeder-vein systems

No USGS descriptive or tonnage-grade models are available for volcanogenic polymetallic layers and veins of the western PNF, which are regarded Ag-Zn-Pb analogues of Kuroko Zn-Cu massive-sulfide layers and (or) their feeder-vein systems.

Description -- volcanic-related Ag-Zn-Pb $\pm$ Cu, Sb, As, Hg, and (or) Ba in layers and lenses, and stratabound veins and disseminations

Volcanic-related polymetallic layers and veins are stratabound layers, lenses, veins, stringers and disseminations of sulfides and sulf-arseno-antimonides of silver, zinc, lead, copper, gold, and mercury that are hosted in or near felsic volcanic strata. They are similar to Kuroko massive sulfides, but veins and disseminations are more common than massive sulfides. They also contain a more varied suite of ore minerals, including galena, sphalerite, chalcopyrite, argentiferous tetrahedrite, wurtzite, marcasite, stannite, and various sulfosalts. Manganoan calcite, which weathers black, is the most common gangue mineral. Sericite and chlorite are typical alteration products (Anderson and Wagner, 1952). These minerals occur in and around stratabound swarms of mineralized fracture zones (breccias, veins, veinlets, and stringers), and also in stratiform disseminations, and semi-massive pods. Vein textures are fine-grained and banded, with concentric and globular forms. Weathering products are malachite, azurite, chalcanthite, cerussite, and hydrous oxides of iron and manganese.

Volcanic-related polymetallic veins have restricted vertical ranges, which (together with their textures) indicates that they formed in abrupt, near-surface (epithermal) temperature-pressure gradients. Polymetallic layers and veins are hosted in and around a distinctive felsic metavolcanic unit (Hendricksen, 1975), which Karen Lund (unpub. data, 1997) mapped as the green rhyolite layer of the Jurassic Weatherby Formation of the Izee terrane. The mineralized felsic metavolcanic unit consists of welded tuff and lapilli tuff, which are geochemically enriched in silver, copper, lead, zinc, barium, arsenic, and mercury, and are interlayered locally with siliceous iron formation (S.E. Church, written commun., 1993). Andesitic metavolcanic rocks that underlie the felsic metavolcanic unit are cut locally by veins and veinlets, interpreted as hydrothermal feeder zones. Overlying metasedimentary rocks are relatively unmineralized.

Interpretation -- volcanic-related polymetallic exhalites, and related veins and disseminations

Mineralized features described above are interpreted to indicate that polymetallic suites of ore minerals were introduced by hydrothermal fluids associated with explosive felsic volcanism; and they were deposited in a near-surface (epithermal) environment, before deposition of overlying sediments. Layers of iron formation and stratiform lenses of disseminated to sub-massive ore minerals probably formed by subaqueous hydrothermal exhalation, and(or) by hydrothermal replacement along relatively permeable layers. The presence of evaporites in the Weatherby Formation, which hosts the polymetallic layers and veins, suggests that sulfate-rich hypersaline brines may have played an important role in the hydrothermal transport of metals.

In the Mineral district, later quartz-tourmaline veins and carbonate-hosted skarns probably formed in association with emplacement of a dioritic stock into the metavolcanic and metasedimentary strata that host the volcanic-related polymetallic deposits (Anderson and Wagner, 1952).

Examples

Lead Zone mine, Edna Mae, Grade Creek, and Thor prospects: The Lead Zone mine, Edna Mae, Grade Creek, and Thor prospects are localities where polymetallic layers and (or) veins are present within the southwestern part of the PNF (fig. 9, appendix B, and pl. 1). They are in the Weiser Ranger District, west of the Cuddy Mountain mining district.

Belmont mine, Houlahan and Hercules prospects: The Belmont mine and the Houlahan and Hercules prospects are just west of the PNF boundary, and west of the Cuddy Mountain mining district. The Hercules prospect was actively explored from 1975 to 1984 (V.E. Mitchell, written commun.). Two large, potentially mineable zones were defined by drilling. They reportedly contain silver, zinc and lead, equivalent in value to 568 tonnes of silver, in about 4 million tonnes of mineralized rock, averaging 142 g silver-equivalent/tonne (American Mines Handbook, 1994).

Mineral mining district: Many polymetallic veins are present in the western part of the Mineral mining district, just west of the PNF. Turner (1908) reported early production as 239 t copper, and 12 to 19 t silver from polymetallic veins of the Mineral mining district (much of which lies west of PNF).

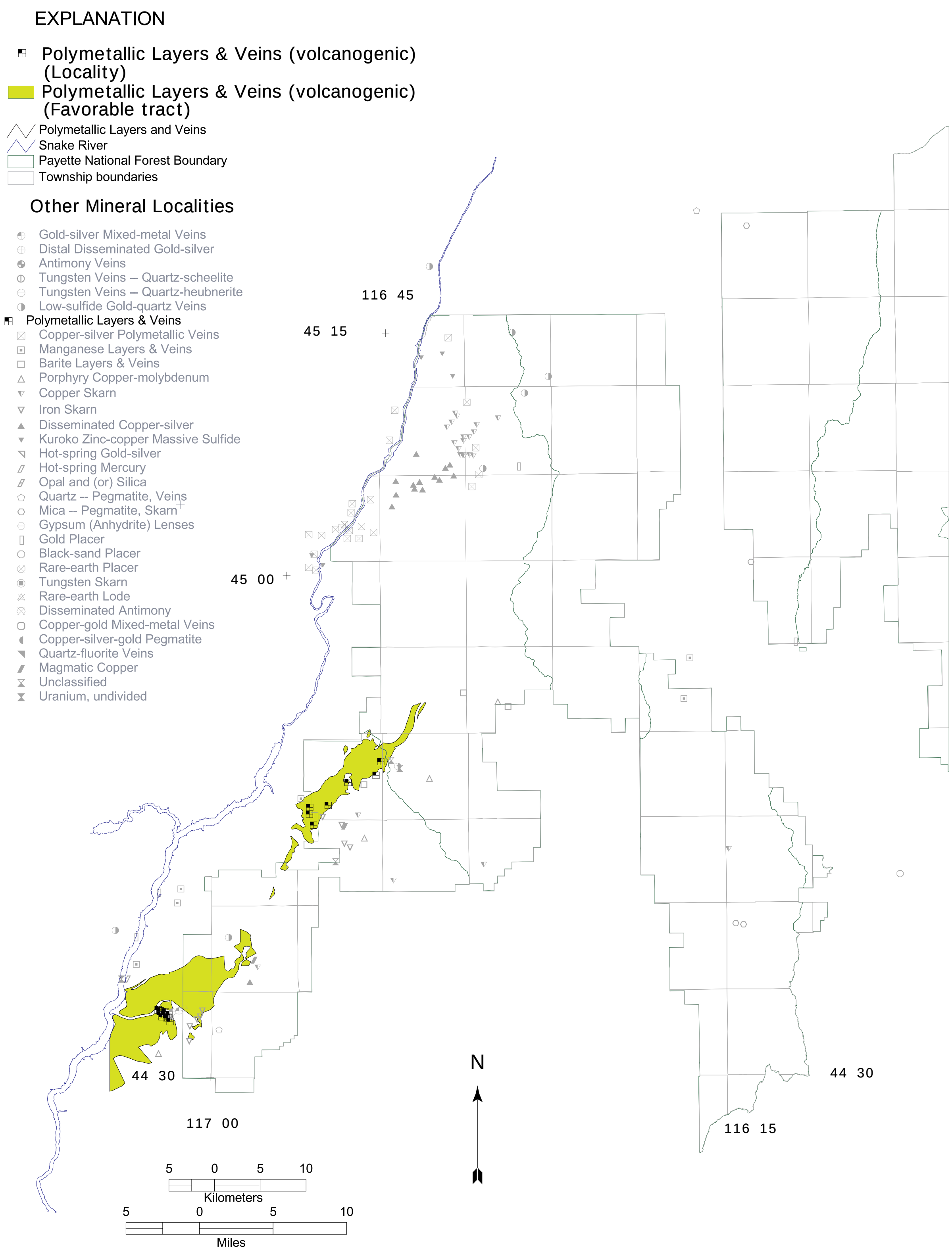


Figure 9. Map showing localities and favorable tracts for volcanogenic Polymetallic Layers and Veins, western PNF.

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is permissive for volcanic-related polymetallic layers and veins, except where it contains igneous intrusions, and where it is covered by more than 1 km of basalt. Favorable tracts for polymetallic layers and veins coincide with exposures of the Jurassic Weatherby Formation of the Izee terrane (fig. 9), which hosts scattered clusters of such deposits along about 40 mi (65 km) of strike length (T.A. Hendricksen, personal communication, 1994).

Reason for no Numerical Estimation

No quantitative estimation of undiscovered resources was made for deposits of this type because no appropriate grade-tonnage models exist. Polymetallic layers and lenses of the Weatherby Formation have structural and textural features in common with the USGS model for Kuroko massive sulfides (Model 28a), but have different assemblages of minerals and commodities.

Polymetallic veins of the Weatherby Formation have some mineralogical and textural features in common with USGS models for polymetallic veins (Model 22c by Cox, 1986a, and Bliss and Cox, 1986). However, the polymetallic vein model does not include a grade-tonnage model for polymetallic veins mined mostly for precious metals. Polymetallic veins of the Weatherby Formation also have some features in common with volcanic-related Sado epithermal veins (Model 25d by Mosier and others, 1986, and Mosier and Sato, 1986). However, most deposits included in the Sado model have higher gold and copper grades than those of polymetallic veins of the Weatherby Formation. Therefore, no USGS mineral deposit model fits well enough to be used for estimation of resources of undiscovered deposits of polymetallic layers and veins of the Weatherby Formation. Furthermore, tonnage grade information is not available for enough individual deposits to allow construction of a new tonnage-grade model for volcanogenic polymetallic layers and veins of the Weatherby Formation.

Development Forecast and Environmental Implications

Mines and prospects on polymetallic layers and lenses in the PNF are unlikely to be developed in the next ten years. Silver generally is their most valuable constituent, and the world market for new silver is dominated by low-cost silver, produced as a byproduct of copper and gold mining. If demand temporarily exceeds supply, existing silver mines could increase production, and the price would come back down before new, relatively high-cost mines could be put into production. Without large-scale mining, the environmental effects of polymetallic layers and veins in the PNF are minor.

Epigenetic, Metavolcanic-hosted Deposits

Epigenetic, metavolcanic-hosted mineral deposits of the western PNF formed mostly during and after lithification and (or) metamorphism of volcanic and sedimentary rocks of accreted terranes of the Blue Mountains Island Arc. Disseminated copper-silver deposits probably formed during lithification and (or) low-grade metamorphism. Copper-silver polymetallic veins probably formed during various stages of lithification and metamorphism. Low-sulfide gold-quartz veins formed mostly during and after dynamothermal metamorphism that accompanied crustal thickening and accretion of the Blue Mountains Island-arc terranes.

Disseminated Copper-silver (volcanic redbed-related)
deposit code 016

USGS model -- no USGS model, but analogous to Sediment-hosted copper

USGS Sediment-hosted copper model (30b, by Cox, 1986b) describes stratabound, disseminated copper sulfides in reduced beds of sedimentary redbed sequences. Disseminated copper-silver deposits of the western PNF are similar, but are hosted in metavolcanic redbed-greenbed sequences.

Geological Survey of Canada (GSC) descriptive model -- Volcanic redbed copper

Volcanic redbed copper deposits are characterized in a GSC mineral deposit model by Kirkham (1995). They occur in predominantly subaerial volcanic sequences, as nearly concordant disseminated deposits, and (or) as crosscutting vein and fault-controlled deposits. These copper deposits are characterized by relatively simple copper sulfide and/or native copper mineral assemblages, and they contain variable amounts of silver. They are widely distributed in subaerial flood basalt sequences, but also are present in island-arc and continental-arc volcanic sequences, and they occur in rocks as felsic as rhyolite. Paleomagnetic and sedimentological evidence indicates that host volcanic sequences were deposited in arid and semiarid, low-latitude areas (Kirkham, 1995).

Description -- disseminated Cu $\pm$ Ag sulfides at red-green transitions in metavolcanic rocks

Disseminated copper-silver deposits of the western PNF are strata-bound and locally stratiform deposits of disseminated copper minerals (chalcocite, bornite, chalcopyrite), and ruby silver minerals (proustite-pyrargyrite). Associated alteration minerals are hematite, chlorite, epidote, sericite, and calcite. The deposits appear to be localized in transition zones, between widespread green, chloritic (reduced) metavolcanic rocks and local zones of red, hematitic (oxidized) rocks.

Interpretation -- diagenetic to metamorphic-hydrothermal deposits, formed at redox boundaries in metavolcanic host rocks

Volcanic-hosted disseminated copper-silver deposits are interpreted as volcanic-hosted analogues of sediment-hosted disseminated copper-silver deposits. The formation of such deposits "depends on a redox reaction between an oxidized brine (containing dissolved copper) and a reductant. The brine, in equilibrium with hematite and free of sulfide, maintains copper in solution as a stable complex ion. The brine source may be trapped seawater or fluids derived from evaporite basins. The copper and silver may be derived from volcanic rock clasts and labile clastic minerals in redbeds, hydrous ferrous oxide cements in redbeds, or subaerial mafic volcanic clasts" (Box and others, 1996, p. 252). Copper-silver bearing oxidized brines migrate into permeable, reduced volcanic and volcaniclastic rocks, where chalcocite, bornite, chalcopyrite, and ruby-silver minerals are deposited at the redox boundary during diagenesis and (or) low-grade metamorphism.

Malachite, azurite and chrysocolla are secondary weathering products of the primary copper-ore minerals. Cuprite may be a secondary mineral, formed by leaching of copper from the oxidizing zone above the water table, and supergene deposition of cuprite in the reducing zone below the water table.

Examples

Disseminated copper-silver deposits are present in the Seven Devils mining district in the Council Ranger District of the PNF. They are hosted in greenschist-facies metavolcanic and metasedimentary rocks of the upper part of the Seven Devils Group of the Wallowa terrane. The largest and best-known deposits of this type are hosted in dark green (reduced, chloritic rocks) that are interspersed with dark reddish-brown (oxidized, hematitic rocks) of the Copper Cliffs and Limepoint Creek sequences of Morganti (1972). These informal stratigraphic units are tentatively correlated with the Wild Sheep Creek Formation of Vallier (1977), which consists of metabasalt, meta-andesite, keratophyre, tuff, conglomerate, sandstone, and argillite. Disseminated copper-silver deposits are localized in keratophyric lava flows and their associated pyroclastic and epiclastic equivalents. Disseminated ore minerals tend to be concentrated near the margins of lava flows, which consist of keratophyre and quartz keratophyre that contain disseminated ilmenite and hematite. Some zones of relatively high-grade ore are concentrated along northeast-trending fold axes (Morganti, 1972). This suggests that copper and silver were mobilized and deposited (or perhaps re-mobilized) during low-grade metamorphism and folding of the host rocks.

The Copper Cliff mine is the largest of 14 first-rank, and 10 second-rank mineral-locality components, classified as volcanic-hosted disseminated copper-silver deposits, as listed in appendix B. These localities are shown on figures 10a and 10b

Copper Cliff mine: The Copper Cliff open-pit mine is about 2.4 km northeast of Cuprum village, on the lower south slope of Horse Mountain, above and between the junctions of Mann and Ladder Creeks with Indian Creek. Past production of the Copper Cliff mine is estimated as approximately 7,120 tonnes of copper and 15.6 tonnes of silver from 907,000 tonnes of ore, with average grades of 0.78 percent copper and 17 ppm silver. Remaining resources are estimated as approximately 1,160 tonnes of copper and 2.26 tonnes of silver in 97,100 tonnes of ore with an average grade of 1.2 percent copper and 23.3 g silver/tonne (Gary Cummings, Alta Gold Co., personal communication, 1995).

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is permissive for disseminated copper-silver deposits, except where it contains post-volcanic plutons, or is covered by more than 1 km of basalt.

Favorable tracts for volcanic-hosted disseminated copper-silver deposits (figs. 10a, 10b) are coincident with favorable tracts for Kuroko massive sulfide deposits. Both types of deposits are present in the same assemblages of metavolcanic and metasedimentary rocks. Most of the known disseminated copper-silver mines and prospects are in the southeastern part of the Seven Devils Mountains, where they are hosted in metavolcanic rocks of the Permian-Triassic Seven Devils Group (Lund, unpub. data, 1997).

Reason for no Numerical Estimation

No numerical estimation was made for undiscovered resources of volcanic-hosted disseminated copper-silver deposits, because appropriate tonnage and grade models are not available for such deposits.

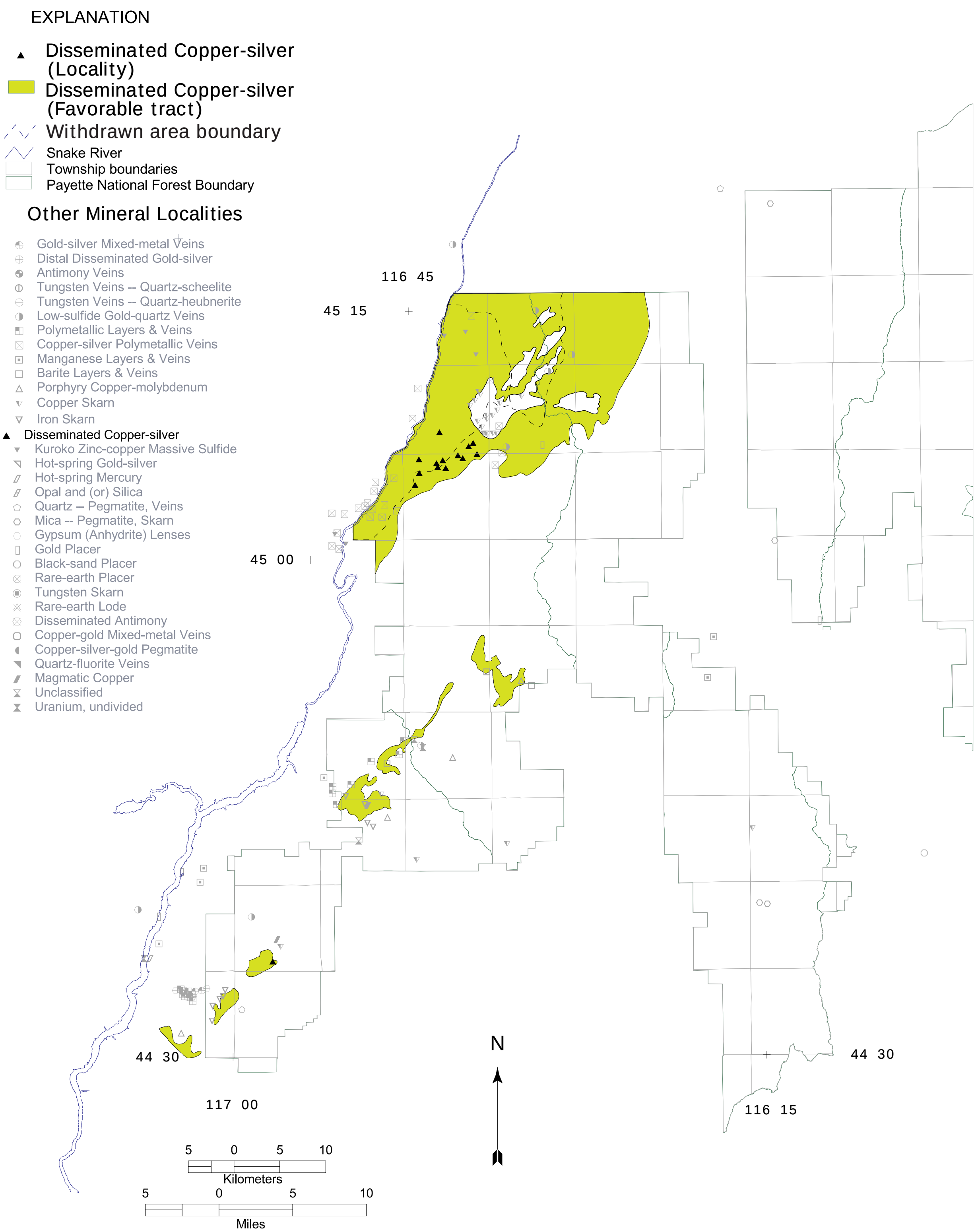


Figure 10a. Map showing favorable tracts for volcanic redbed-hosted Disseminated Copper-silver deposits and localities with Disseminated Copper-silver as a first-rank component, western PNF.

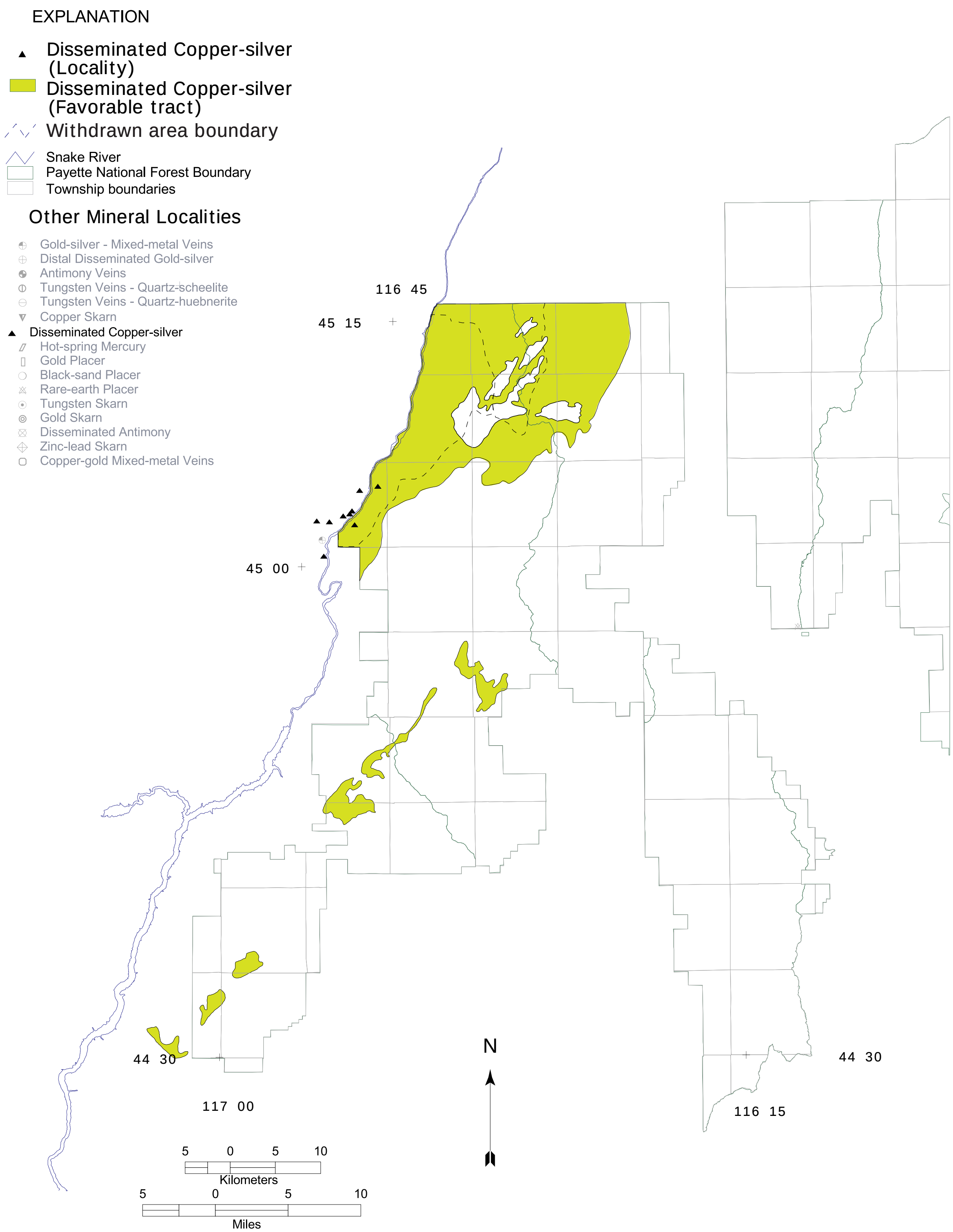


Figure 10b. Map showing favorable tracts for volcanic redbed-hosted Disseminated Copper-silver, and localities with Disseminated Copper-silver as a second-rank component, western PNF.

Development Forecast

Remaining resources of the Copper Cliff mine may support renewed mining if future prices of copper and (or) silver were to increase significantly. In such circumstances, exploration activity could be expected within and around the Copper Cliff deposit, and along the southeastern margin of the Seven Devils Mountains favorable tract.

Environmental Effects and Implications

Water in the pond at the bottom of the open pit of the Copper Cliff mine was dark green and translucent in September of 1994. Orange-brown hydrous iron oxide coated rocks around the pond margins to water depths of about 6 ft (2 m). The water had high pH (8.81) and high alkalinity (0.676 meq/L). Filtration through 0.2 micron filters was slow and difficult. Five plugged filters indicated that the water contained abundant suspended sediment. The filtered sample contained 105 ppm sulfate, 28 ppm calcium, 6.3 ppm magnesium, and rather low concentrations of zinc (35 ppb), copper (26 ppb), and manganese (12 ppb).

Volcanic-hosted disseminated copper-silver deposits contain little pyrite and are hosted in calcite-bearing greenstones. The deposits therefore have little acid potential for acid generation, combined with moderate acid-buffering capacity. Weathering of their mine and mill wastes therefore produces alkaline drainage waters with relatively low concentrations of acid-soluble metals, such as copper and zinc. Nevertheless, surface disturbances resulting from open pits and piles of waste rocks and pulverized mill tailings are susceptible to rapid erosion unless stabilized.

Environmental clean-up operations were underway at the Copper Cliff mine and mill sites in September of 1994. The northern pit wall had been draped with chain-link fencing to control rock falls, and mill tailings were being re-contoured.

Copper-silver Polymetallic Veins (metamorphic-hydrothermal)

deposit code 010

USGS model -- no USGS model

Description -- copper-dominant polymetallic veins with silver

Copper-silver polymetallic veins are quartz veins that have been prospected and mined on a small scale for copper, with byproduct silver, and variable amounts of zinc, lead, molybdenum, iron, and gold. These quartz veins commonly contain seams of chalcopyrite, chalcocite, and(or) bornite, and argentiferous tetrahedrite $\pm$ sphalerite, galena, molybdenite, pyrite, and (or) gold. Malachite and azurite are common weathering products.

At least three subtypes of copper-silver polymetallic veins are present in the Seven Devils Mountains, in the northwestern corner of the PNF: 1. zinc-bearing copper-silver polymetallic veins, possibly associated with Kuroko massive sulfides (Close, 1993), 2. copper-silver veins, spatially associated with metavolcanic-hosted disseminated copper-silver deposits, and 3. copper-silver polymetallic veins, hosted in the margins of a chloritized quartz-diorite pluton that intrudes metavolcanic rocks of the Seven Devils Group.

Interpretation -- mostly metamorphic-hydrothermal Cu-Ag polymetallic quartz veins

Copper-silver polymetallic veins are interpreted as hydrothermal veins that formed at various stages of lithification and metamorphism of metavolcanic rocks of the Blue Mountains Island Arc.

Examples

Azurite mine: The Azurite mine is about 9 km southeast of Cuprum, in a shear zone that transects layering in meta-andesite and (or) meta-rhyolite tuff. Quartz veins along the shear zone contain calcite, barite, dolomite, and siderite, with shoots of bornite, sphalerite, tetrahedrite, pyrite, galena, and chalcopyrite. The Azurite mine produced about 1,530 tonnes of ore, from a vein as thick as 1.5 m, exposed in mine workings for 120 m along strike. Average ore grade was 148 g/t silver, 1.26 wt percent copper, 2.14 wt percent zinc, and 0.09 wt percent lead (Close, 1993, p. 45). The high zinc and copper contents of the ore suggests an affinity with Kuroko zinc-copper massive sulfides, like those of the Red Ledge deposit. Such veins may have formed during hydrothermal alteration of volcanic rocks beneath submarine hot spring vents.

Cliff prospect: The Cliff prospect is north of the Red Ledge zinc-copper massive sulfide deposit, and is hosted in a similar meta-rhyolite that is silicified, sericitized, and pyritized. The rock contains a vuggy, copper-stained quartz vein that contains pyrite, chalcopyrite, cuprite, and bornite. Six samples taken by the USBM contained 0.5 to 5.7 wt percent copper, 30 to 102 ppm silver, and 0 to 36 ppm gold (Close, 1993). This prospect lacks zinc, and is mineralogically similar to disseminated copper-silver deposits, except that it contains more quartz and pyrite.

Lime Peak prospect: The Lime Peak prospect is on Lime Peak, about 2 km northeast of the confluence of Limepoint Creek with Hells Canyon Reservoir (Close, 1993). Copper minerals (chalcopyrite, bornite, tetrahedrite, chalcocite, malachite, and azurite) are localized in and around small veins of white quartz, but also occur as lenses and disseminations in red tuff and greenstones. This prospect has many of the characteristics of disseminated copper-silver deposits, but it also has quartz veins.

Lucky Strike and Panama Pacific prospects: The Lucky Strike and Panama Pacific prospects are on quartz veins that contain chalcopyrite, bornite, and covellite. These veins are hosted in quartz diorite near margins of the pluton of White Monument (a quartz-diorite pluton of Jurassic-Cretaceous age that intrudes greenstones of the Seven Devils Group).

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is permissive for Cu-Ag polymetallic veins, except where covered by more than 1 km of basalt. Favorable tracts are delineated to include known examples of such veins and the metavolcanic, metasedimentary, and plutonic rocks that contain them in the western PNF (fig. 11).

Reason for no Numerical Estimation

No numerical estimation was made for undiscovered resources of volcanic-hosted copper-silver polymetallic veins, because appropriate tonnage and grade models are not available for such deposits.

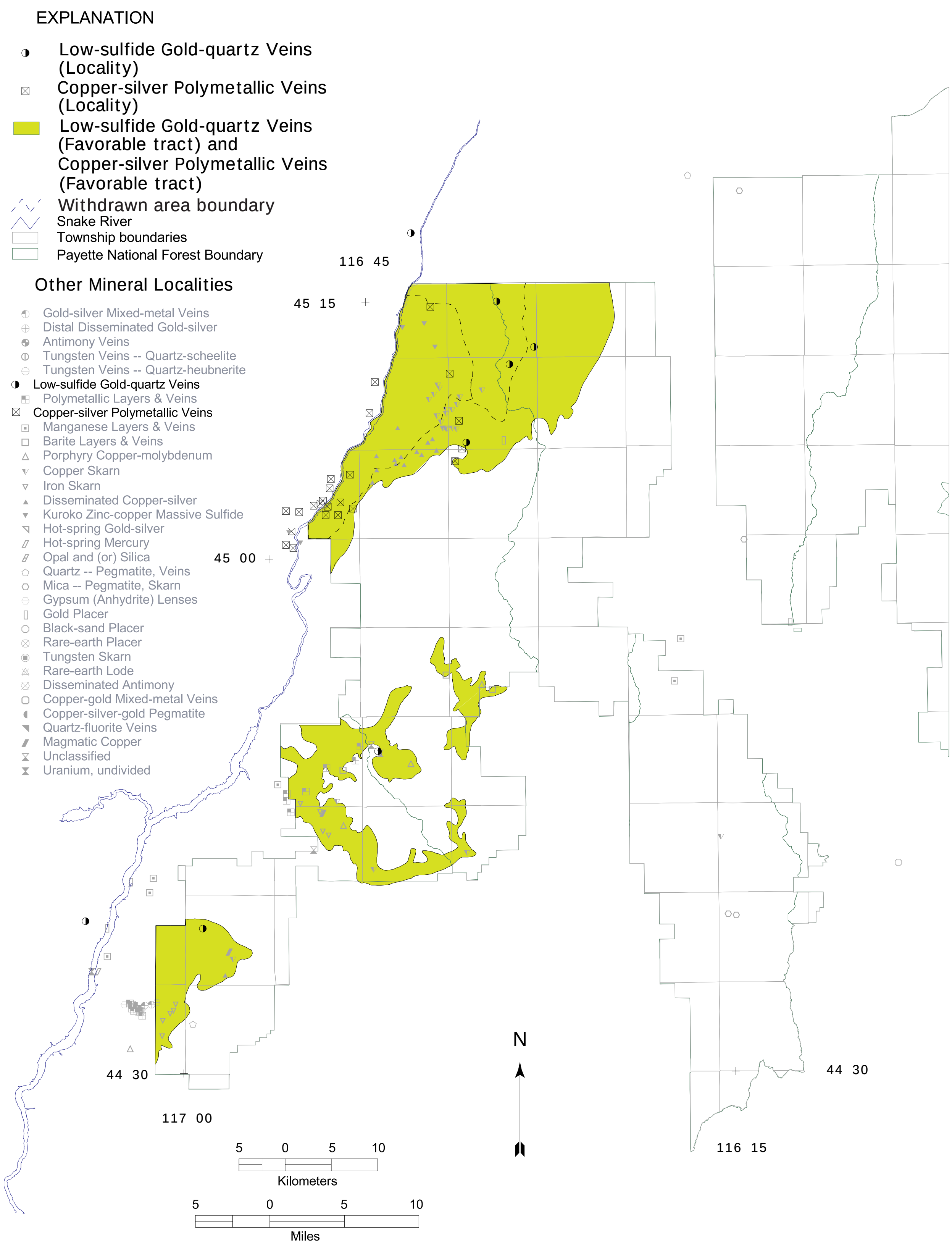


Figure 11. Map showing localities and favorable tracts for Copper-silver Polymetallic Veins, and for Low-sulfide Gold-quartz Veins, western PNF.

Development Forecast and Environmental Implications

It is unlikely that volcanic-hosted copper-silver polymetallic veins will be developed in the foreseeable future. Minor surface disturbances resulting from small mine or exploration workings on copper-silver polymetallic veins are the only environmental effects expected.

Low-sulfide Gold-quartz Veins (metamorphic-hydrothermal)

deposit code 007

USGS model -- Low-sulfide Au-quartz veins, or Chugach-type low-sulfide Au-quartz veins

USGS descriptive model 36a, for Low-sulfide Au-quartz veins was written by Berger (1986). The USGS grade-tonnage model for Low-sulfide Au-quartz veins, by Bliss (1968), indicates a median size of 30,000 tonnes, and a median grade of 16 g Au/tonne. Chugach low-sulfide Au-quartz veins are a subset of turbidite-hosted veins that are smaller and lower-grade, with a median size of 3,200 tonnes, and a median grade of 6.2 g Au/tonne (USGS model 36a.1, by Bliss, 1992a). A USGS geoenvironmental model for Low-sulfide Au quartz veins was written by Goldfarb and others (1995).

Description -- gold-bearing quartz veins

Low-sulfide gold-quartz veins are quartz veins that are mined for their gold content. They generally contain no more than 2 to 3 volume percent sulfide minerals, such as pyrite and native gold ± minor galena, sphalerite, chalcopyrite, arsenopyrite, and (or) pyrrhotite (Berger, 1986a). Such veins are present in accreted terranes dominated by greenstone and turbidite sequences that have been metamorphosed to greenschist facies (Goldfarb and others, 1995). Alteration envelopes adjacent to some low-sulfide gold-quartz veins contain carbonate and (or) micaceous minerals with disseminated sulfides and low-grade gold. In western PNF, low-sulfide gold-quartz veins are present in greenstone belts that consist of metavolcanic and metasedimentary rocks, and in greenstone-hosted igneous intrusions.

Interpretation -- metamorphic-hydrothermal gold-bearing quartz veins in greenstone terranes

Low-sulfide gold-quartz veins are interpreted as metamorphic-hydrothermal veins that form during and after episodes of cratonization (crustal thickening, regional metamorphism and plutonism, associated with collision and accretion of oceanic volcanic island arcs to continental cratons).

Examples

Table 1 and appendix B list 8 first-rank examples of low-sulfide gold-quartz veins in the PNF and vicinity, 6 in the western PNF, and 2 north and west of it. The 6 low-sulfide gold-quartz veins within PNF are in the Seven Devils, Crooks Coral, and Mountain View mining districts, and north of the Mineral mining district (fig. 11).

Black Lake (Maid of Erin) mine: Before 1915 the Black Lake (Maid of Erin) low-sulfide gold-quartz vein mine produced 0.26 tonnes of gold from about 16,000 tonnes of ore averaging 16 ppm Au from underground workings (converted from Livingston and Laney, 1920).

Placer Basin mine: From 1935 to 1937 the Placer Basin low-sulfide gold-quartz vein mine produced about 0.13 tonnes of gold from 3,100 tonnes of ore averaging 43 ppm Au from underground workings (converted from Cook, 1954, and USBM, 1996).

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is considered permissive for low-sulfide Au-quartz veins, except where covered by more than 1 km of basalt. Favorable tracts were delineated to include known examples of low-sulfide Au-quartz veins, and the metavolcanic, metasedimentary, and plutonic rock units that contain them in the western PNF. The assessment tract includes all favorable tracts as subunits.

Rationale for Numerical Estimation

Unlike Chugach-type veins, low-sulfide Au-quartz veins of the western PNF are hosted mostly in metavolcanic greenstones, not in turbidites. Although the tonnage of ore produced from the Black Lake mine was smaller than that of 85 percent of Low-sulfide gold-quartz veins, the amount produced was much larger than that of most Chugach-type veins. Furthermore, the grade of ore produced from the Black Lake and Placer Basin mines was close to the median grade of Low-sulfide Au-quartz veins, and was much higher than that of Chugach-type veins. Therefore, the assessment team decided to estimate undiscovered resources using the grade-tonnage model for Low-sulfide Au-quartz veins by Bliss (1986). Estimation of numbers of undiscovered deposits was done by counting targets, considering the favorability of their attributes, and subjectively estimating how many targets are likely to fit between the 10th and 90th percentiles of the tonnage and grade models for low-sulfide gold-quartz veins. This was done for a range of levels of subjective probability, as follows.

For the 90th, 50th, 10th, 5th, and 1st percentiles of subjective probability, the team estimated 0, 0, 2, 4, and 7 undiscovered deposits compatible with the tonnage-grade model for low-sulfide gold-quartz veins. These estimates were made using a target-counting approach. They convey the group opinion that the area is well explored, that most of the occurrences with potential to match the tonnage-grade have been found, and there is a high level of uncertainty as to whether undiscovered resources are large enough to fit the tonnage-grade model. Results of the estimation of undiscovered resources in low-sulfide gold-quartz veins are summarized in Table 6.

Development Forecast

Individuals and small companies may explore for low-sulfide gold-quartz veins, and may try to develop small-scale underground mining operations on them. A recent trend has been to explore for relatively large-tonnage, low-grade gold deposits in altered host rocks adjacent to and (or) between Low-sulfide gold-quartz veins. Such deposits may have potential to be developed by relatively low-cost open-pit mining and heap leaching to recover gold. Nevertheless, given the relatively small sizes and remote locations of known low-sulfide Au-quartz deposits in the PNF, it is considered unlikely that significant development of such deposits will occur in the next ten years.

Table 6. Low-sulfide Gold-quartz Veins: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Low-sulfide Gold-quartz Veins (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	0	2	4	7

Mark 3 output

Estimate of probability of 0 deposits: 61%

Estimate of probability of the median number of deposits (0): 61%

Estimate of mean expected number of deposits: 0.81

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Low-sulfide Gold-quartz Veins (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
gold	0	0	6.6	5.7	11%
silver	0	0	0.00044	0.97	3%
ore	0	0	560,000	840,000	8%

Environmental Effects and Implications

Goldfarb and others (1995) list the following possible environmental problems associated with mining of low-sulfide Au-quartz veins: 1. Production of moderate amounts of acid mine drainage, 2. Release of potentially hazardous arsenic and antimony species from oxidizing mine wastes and (or) mill tailings, 3. Mercury contamination in surface sediment and aquatic life, as a result of historic extraction of gold by mercury amalgamation, 4. Cyanide contamination as a result of gold extraction by cyanidation, 5. Sedimentation problems caused by erosion and transport of mine wastes and mill tailings. Inasmuch as near-term development of Low-sulfide Au-quartz veins is unlikely in the PNF, such environmental problems are only likely to occur in and around historic mining and milling operations.

Intrusion-Related Deposits

Magmatic iron-copper, iron skarns, copper skarns, and porphyry copper-molybdenum prospects are associated with gabbroic, quartz-dioritic, and granodioritic intrusions that were emplaced into accreted terranes of the Blue Mountains Island-arc after the peak of regional dynamothermal metamorphism.

Magmatic Iron-Copper

deposit code 038

USGS model -- no USGS model

Description of Example -- magnetite and chalcopyrite in gabbro

Table 1 and appendix B list one magmatic iron-copper locality, which is on Cuddy Mountain at the head of East Brownlee Creek (fig 14). Fankhauser (1969) describes the prospect as several small pits in hornblende gabbro that contains magnetite (to 20 percent) and chalcopyrite (to 1 percent) in small pods, lenses, stringers, irregular masses and disseminations.

Interpretation -- magmatic segregations of magnetite and chalcopyrite in gabbro

Fankhauser (1969) interpreted the gabbro-hosted magnetite-chalcopyrite occurrences of East Brownlee Creek as magmatic segregations. The gabbroic intrusion that hosts these magnetite-chalcopyrite segregations is interpreted as a mafic member of a set of intrusions that range in composition from gabbro, to quartz diorite, to granodiorite. These were emplaced into previously deformed and metamorphosed greenstones of the Blue Mountains island arc assemblage. Iron skarns and (or) copper skarns are present within and around some quartz diorite plutons, and porphyry copper prospects are associated with some porphyritic granodiorite plutons. The magmatic iron-copper deposits of East Brownlee Creek are interpreted as early mafic-magmatic manifestations of a tendency for concentration of iron and copper within and around plutons of this set of intrusions.

Development Potential

Only one small magmatic copper prospect is known, and it appears to have no development potential. Therefore, permissive and favorable tracts were not delineated, and no numerical estimations were made of potential mineral resources.

Iron Skarn
Deposit Code 015

USGS model -- Fe skarn

USGS Fe-skarn descriptive model 18d (Cox, 1986c) is accompanied by a grade-tonnage model by Mosier and Menzie (1986). Iron skarns are more fully characterized in a descriptive model for seven major classes of skarns and skarn deposits by Meinert (1993).

Description -- Fe oxides ± Cu- and Fe-bearing sulfides in calc-silicate rocks

Iron skarns contain magnetite in calc-silicate rocks near igneous intrusions of mafic to felsic composition (Cox, 1986c, p. 94). Common calc-silicate minerals are Ca-Fe garnet and pyroxene, followed by late-stage amphibole, epidote, and chlorite. Primary ore minerals include abundant magnetite ± subordinate chalcopyrite, pyrrhotite, and (or) pyrite. Secondary ore minerals include hematite, limonite, and malachite.

Interpretation

Iron skarns of the western PNF are spatially associated with quartz-diorite and granodiorite intrusions of Jurassic age. Bruce (1970) reported isotopic age determinations of 200 ± 5 Ma for quartz diorite, and 180 ± 5 Ma for granodiorite. Iron skarns formed by thermal metamorphism and metasomatism (hydrothermal replacement) of calcium- and (or) carbonate-bearing metavolcanic and metasedimentary rocks, within or near such intrusions.

Examples

Mineral mining district, Iron Mountain mining area: Table 1 and appendix B list 9 first-rank examples of iron skarn in the western PNF. Several small iron mines and prospects are present in the Iron Mountain mining area of the Mineral mining district, in the southwestern Hitt Mountains. There, iron skarns are localized near a quartz-diorite intrusion, and they are hosted in marble beds of the Triassic Huntington Formation (Karen Lund, unpub. data, 1997). Brown garnet and gray-green amphibole, and chlorite are common in these skarns. Abundant magnetite ± chalcopyrite ± hematite characterizes iron skarns of the Campbell, Mortimer, Montana, and Standard Specularite mines and prospects. Red hematite is predominant at the Abundance mine, common at the Montana prospect, and present at the Standard Specularite prospect. The red hematite is overlain by Tertiary basalt flows. The hematite probably formed by pre-basalt weathering of magnetite, followed by oxidative baking beneath the basal basalt flows.

Cuddy Mountains: In the Cuddy Mountains, the Iron, Climax, and Metheny prospects are on copper-bearing iron skarns that are hosted in metasedimentary and metavolcanic greenstones of the Huntington Formation (Karen Lund, unpub. data, 1997). The copper-bearing iron skarns are localized near a granodiorite intrusion.

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is permissive for iron skarns, except where covered by more than 1 km of basalt. Known iron skarns are hosted in metasedimentary and metavolcanic rocks of the Triassic Huntington Formation (of the Olds Ferry terrane), and they are localized in contact zones within about 2 km of Jurassic quartz diorite and granodiorite intrusions. Therefore, favorable tracts (fig. 12) are limited to areas of Huntington Formation within 2 km of intrusions of quartz diorite and granodiorite.

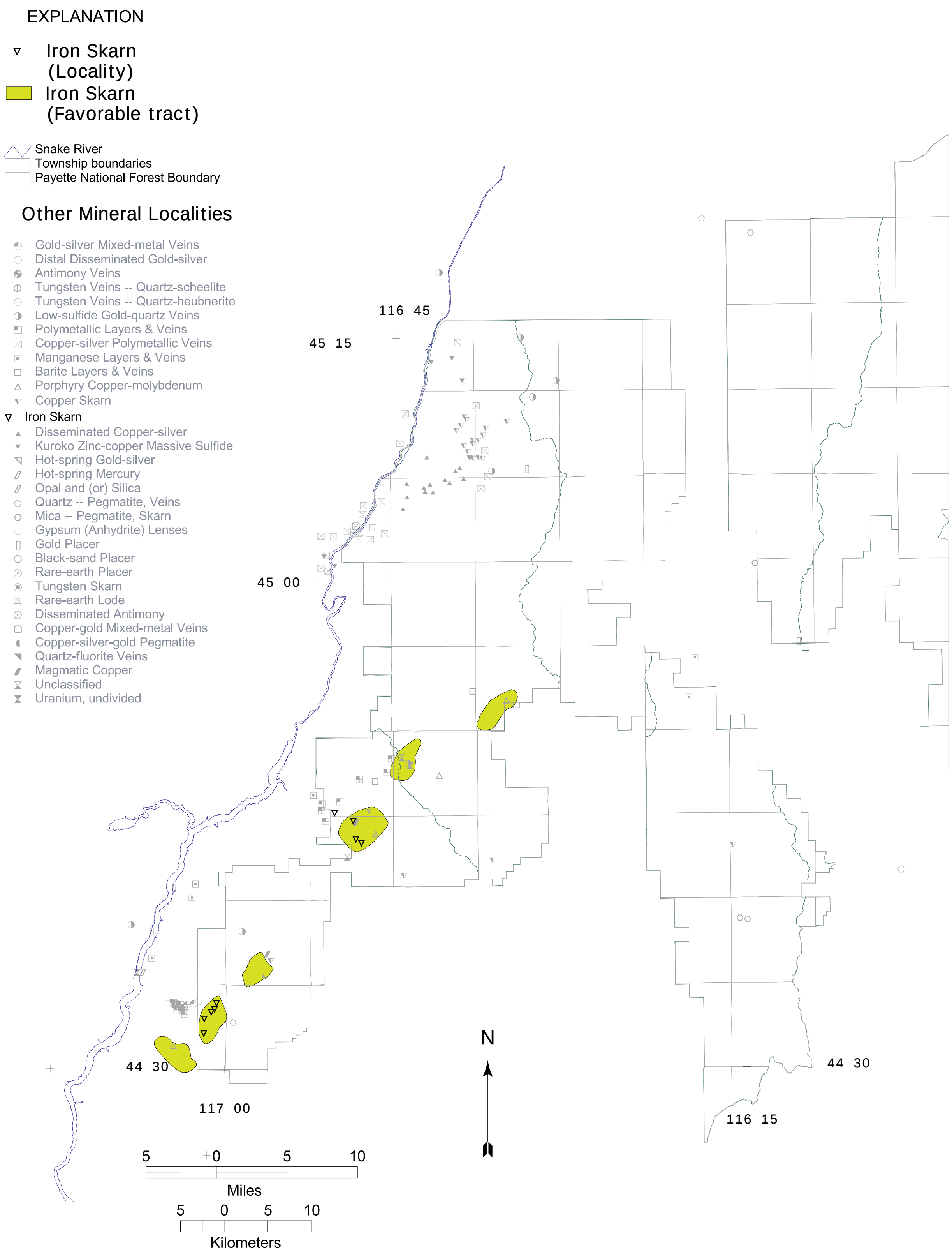


Figure 12. Map showing localities and favorable tracts for Iron Skarn, western PNF.

Reason for no Numerical Estimation

Mackin (1953) estimated about 140,000 to 180,000 tonnes of iron-rich material available for open-pit mining in the Iron Mountain area. However, no estimation was made of undiscovered resources, because the combined tonnage estimated by Mackin is less than the tenth percentile of tonnage (330,000 metric tonnes) for iron skarns represented in the iron-skarn model by Mosier and Menzie (1986).

Development Forecast and Environmental Implications

It is very unlikely that iron skarns of the PNF will be developed in the foreseeable future, because much larger, lower-cost sources of iron ore are available. Furthermore, grades of associated copper and silver are not high enough to support development. Without future development, environmental disturbances will be limited to those caused by existing mines, prospects, and access roads and trails.

Copper Skarn

deposit code 014

USGS model -- Cu skarn

USGS Cu-skarn descriptive model (18b), by Cox and Theodore (1986), is accompanied by a tonnage-grade model for Cu skarn deposits by Jones and Menzie (1986a). Copper skarns are more fully characterized in a descriptive model for seven major classes of skarns and skarn deposits by Meinert (1993). A USGS geoenvironmental mineral deposit model for Cu, Au, and Zn-Pb skarns was written by Hammarstrom and others (1995).

Description -- Cu ± Fe sulfides in calc-silicate rocks

Copper skarns contain chalcopyrite in calc-silicate rocks near igneous intrusions of intermediate to felsic composition (Cox, and Theodore, 1986). Common gangue minerals include Ca-Fe garnet and pyroxene, followed by late-stage amphibole, epidote, chlorite, quartz, calcite, and clay minerals. Primary ore minerals include chalcopyrite + pyrite ± pyrrhotite, bornite, tetrahedrite, molybdenite, magnetite, and (or) hematite. “Ore minerals may be present in massive, stratiform, vein, and(or) disseminated form. Grain size is highly variable, and ranges from fine to very coarse” (Hammarstrom and others, 1995). Secondary covellite, chalcocite, cuprite, malachite, azurite, and limonite also are common.

Interpretation

Copper skarn tends to form where a pluton of intermediate to felsic composition intrudes strata that include limestone or other calcium- and (or) carbonate-bearing rocks. Copper skarns of the western PNF formed where quartz-diorite and granodiorite plutons intruded calcium- and (or) carbonate-bearing metasedimentary and metavolcanic rocks of the Blue Mountains Island Arc. Host rocks are of Permian to Jurassic age, and skarn-related plutons are of Jurassic age. Bruce (1970) reported isotopic age determinations of 200 ± 5 Ma for quartz diorite, and 180 ± 5 Ma for granodiorite. Exoskarns formed outside the plutons, and endoskarns formed within them. Copper skarns formed by thermal metamorphism, prograde metasomatism, and fracture-controlled retrograde hydrothermal replacement.

Examples

Table 1 and appendix B list 17 copper skarns in the Seven Devils mining district, four in the Cuddy Mountain mining district, one in the Mineral district, and one in the West Mountains of the western PNF.

Seven Devils mining district: In the Seven Devils mining district, at least 17 copper skarns are present northeast of the village of Cuprum. Those copper skarns are localized around and within the Jurassic quartz-diorite stock of the White Monument area. Many are exoskarns that are clustered along the southern and western margins of the stock, where the stock is in contact carbonate-bearing metasedimentary rocks of the Wallowa terrane. Others are endoskarns that are localized along a band of inclusions (or roof-pendants) that extends northeasterly, across the stock. Copper skarns of the Seven Devils district are described by Livingston and Laney (1920); Cook (1954); Cannon and Grimaldi (1953); and Close, 1993).

Copper skarns of the Seven Devils district appear to have formed at relatively deep levels with respect to the associated quartz diorite stock of the White Mountain area. The quartz-diorite is predominantly phaneritic, rather than porphyritic, and alteration of the stock is mostly chloritic. No evidence was seen for pervasive quartz-pyrite-chalcopyrite veining and associated potassic to phyllic alteration assemblages associated with porphyry copper systems, or for distal precious-metal geochemical anomalies of distal disseminated Au-Ag deposits.

The Peacock copper skarn, in the Seven Devils mining district, contains cuprite and chalcocite after bornite and covellite in calc-silicate gangue, with malachite and azurite coatings. Recorded production is 539 tonnes of copper, 6.7 tonnes of silver, and 0.06 tonnes of gold from 36,200 tonnes of ore, with an average grade of 1.49 percent copper and 185 ppm silver. Identified resources are 5,400 tonnes of copper, 9.5 tonnes of silver, and 0.06 tonnes of gold in 400,000 tonnes of ore, with an average grade of 1.35 percent copper, 23.8 ppm silver, and 0.17 ppm gold (USBM, 1996, converted here from short tons and ounces to metric tonnes and ppm, or g/tonne).

The South Peacock copper skarn, in the Seven Devils mining district, is somewhat smaller than the median of deposits included in the tonnage and grade models for copper skarns by Jones and Menzie (1986a). It contains covellite, cuprite and chalcocite after chalcopyrite and bornite in calc-silicate gangue, with malachite and chrysocolla coatings. Past production was recorded with that of the Peacock mine. Identified resources are 23,000 tonnes of copper and 2.6 tonnes of silver in 1,450,000 tonnes of ore, with an average grade of 1.59 percent copper and 18.8 ppm silver (converted here from USBM, 1996, p. A-127).

The Blue Jacket copper skarn, in the Seven Devils mining district, was a small, high-grade deposit that contained chalcocite, argentite, and covellite, after chalcopyrite, bornite, and tetrahedrite, in calc-silicate gangue. Recorded production is 420 t copper, 367 kg silver, and 3.7 kg gold from 1,850 t ore, averaging 22.7 wt percent copper, 198 ppm silver, and 2 ppm gold (converted here from USBM, 1996, p. A-38). Intermittent production continued until 1942, and remaining resources are have not been estimated.

Cuddy Mountain mining district: In the Cuddy Mountain mining district, copper skarns are present at the Railroad mine, and at the Rush Peak, Goodrich Creek Canyon, and Metheney prospects. Copper skarns of the Cuddy Mountain district are spatially associated with stocks of quartz-diorite and granodiorite that intrude, and contain inclusions of metavolcanic and metasedimentary rocks of the Blue Mountains Island Arc. The

Railroad mine was active in the 1970s (Bruce, 1971). It contains chalcopyrite and bornite in calc-silicate gangue. Recorded production is 2.3 tonnes of copper, with minor silver and gold (converted here from USBM, 1995, p. A-113). Copper skarns of the Cuddy Mountains are spatially associated with porphyry copper-molybdenum prospects, hosted in granodiorite stocks.

Other copper skarns: Other copper skarns in the western PNF include the Skarn prospect in the Mineral mining district, and the Granite Queen prospect in the West Mountains.

Rationale for Tract Delineation

The Blue Mountains Island Arc (figs. 4 and 5) is permissive for copper skarns, except where covered by more than 1 km of basalt. Carbonate layers, lenses, and pods are widely scattered and mostly unmapped. Some porphyry intrusions crop out. Others may be hidden in the subsurface.

Favorable tracts for copper skarns include all igneous intrusions and their surrounding host rocks to a distance of about 1 km from their mutual contacts in the western PNF, as shown in figure 13. The Assessment tract includes all favorable tracts as subunits.

Rationale for Numerical Estimation

The grade-tonnage model for copper skarns indicates a median size of 560,000 tonnes with median grade of 1.7 percent copper (Jones and Menzie, 1986a). The Peacock and South Peacock deposits fit the copper skarn model, but the Blue Jacket deposit is smaller and higher-grade than the deposits included in the model. The assessment team therefore decided to estimate undiscovered resources using the grade-tonnage model by Jones and Menzie (1986a).

Estimation of numbers of undiscovered deposits was done by counting targets, considering the favorability of their attributes, and subjectively estimating how many targets are likely to fit between the 10th and 90th percentiles of the tonnage and grade models for copper skarn deposits. For the 90th, 50th, 10th, 5th and 1st percentiles of subjective probability, the team estimated 0, 2, 3, 7, and 10 undiscovered deposits that would range in size and grade between the 90th and 10th percentiles of the grade-tonnage model. Results of the estimation of undiscovered resources in copper skarns are summarized in Table 7.

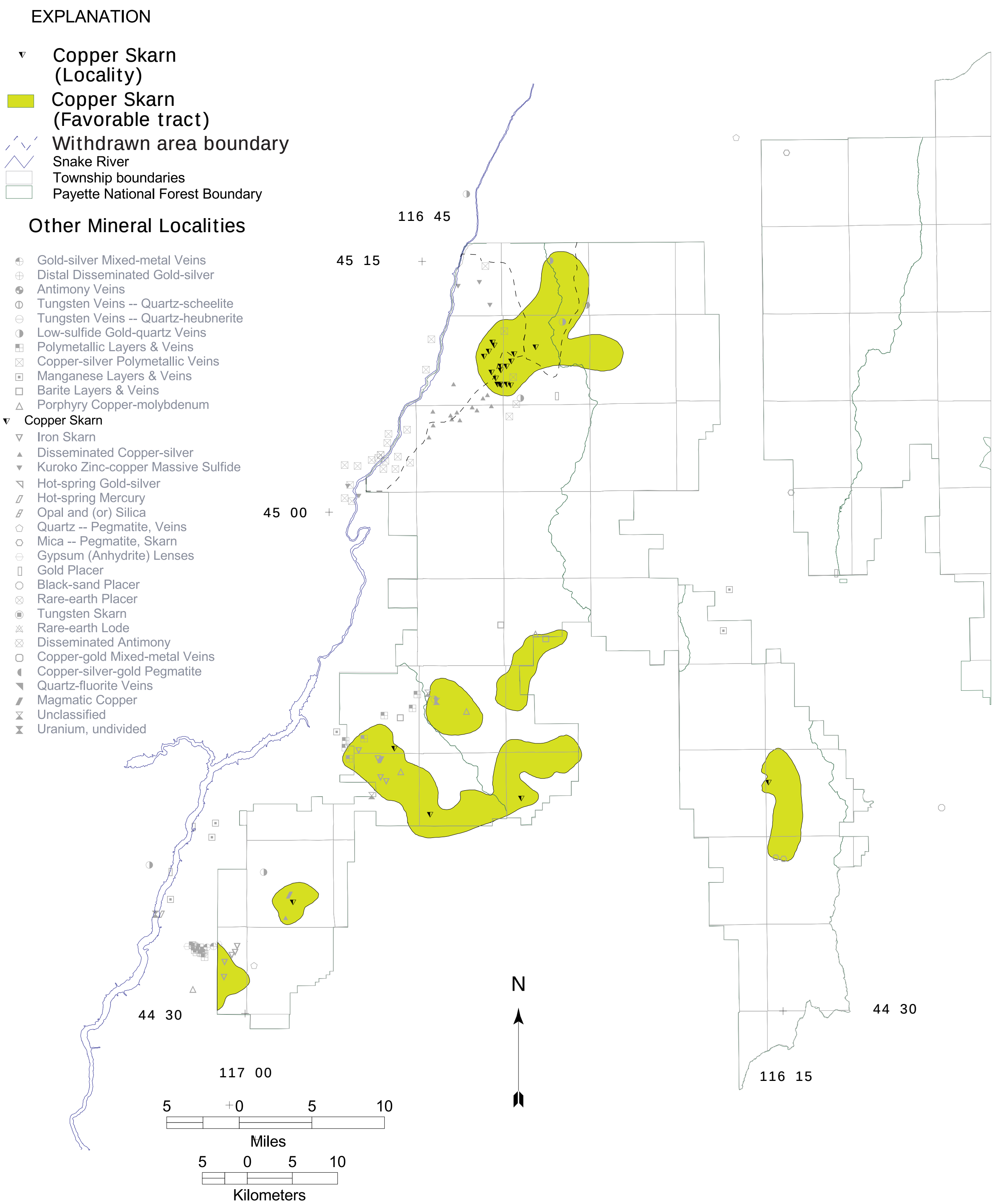


Figure 13. Map showing localities and favorable tracts for Copper Skarn, western PNF.

Table 7. Copper Skarn: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Copper Skarn (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	2	3	7	10

Mark 3 output

Estimate of probability of 0 deposits: 19%

Estimate of probability of the median number of deposits (2): 30%

Estimate of mean expected number of deposits: 2.1

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Copper Skarn (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
copper	0	23,000	370,000	130,000	24%
gold	0	0	3.8	2	15%
silver	0	0	41	16	21%
ore	0	1,300,000	27,000,000	9,600,000	23%

Development Forecast

Copper skarns of the western PNF have been developed by small-scale open-pit and underground mining methods. It is unlikely that copper skarns of the western PNF will be further developed in the next ten years, because they would be high-cost producers relative to much larger copper deposits that are already in production elsewhere. Some smelters pay a premium for copper skarn ore, as a copper-bearing flux. However, copper skarns of the PNF are far from the nearest copper smelter (near Salt Lake City, Utah), so it is unlikely that they will become economic as smelter flux in the foreseeable future.

Environmental Effects and Implications

Surface and groundwater associated with sulfide-mineral-rich waste rocks (in-situ, on dumps, or in tailings piles) may be acidic, and may contain elevated concentrations of dissolved iron, aluminum, and copper (Hammarstrom and others, 1995). Endoskarns with little remaining carbonate probably have less acid-buffering capacity than exoskarns with nearby marble and (or) limestone outcrops.

Porphyry Copper-molybenum

deposit code 013

USGS models -- Porphyry Cu-Mo, Porphyry Cu, or Porphyry Cu deposits in British Columbia and Alaska

USGS Porphyry Cu-Mo descriptive model 21a by Cox (1986d) is accompanied by a tonnage-grade model by Singer, Cox, and Mosier (1986). USGS Porphyry Cu descriptive model 17 by Cox (1986e) is accompanied by a tonnage-grade model by Singer, Mosier, and Cox (1986). An alternative tonnage-grade model, for a subset of smaller, lower-grade porphyry copper deposits in British Columbia and Alaska, was compiled by Menzie and Singer (1993). Cox and others (1995) wrote a descriptive geoenvironmental model for porphyry copper deposits. Kirkham and Sinclair (1996) wrote descriptive and genetic models for porphyry copper, gold, molybdenum, tungsten, tin, and silver deposits. They presented a graph that illustrates the variation in Cu and Mo grades of porphyry Cu, porphyry Cu-Mo, and porphyry Mo deposits.

Description -- stockworks of Cu- and Mo-bearing veinlets, in or near porphyries

Porphyry copper-molybdenum deposits are stockworks of veinlets of quartz, chalcopyrite, pyrite, and molybdenite in or near a porphyritic intrusion of tonalite to monzogranite composition (Cox, 1986d). Individual orebodies measure hundreds to thousands of meters in all three dimensions, and ore grade tends to increase with decreasing spacing of veins and veinlets (Kirkham and Sinclair, 1996; Cox, 1986d). Porphyry copper-molybdenum systems are characteristically zoned, with central quartz-molybdenite stockworks, medial quartz-chalcopyrite stockworks ± skarns, peripheral pyrite-stockworks, and distal zones of lead-zinc veins ± precious-metal veins, replacements and (or) disseminations. Alteration assemblages also are characteristically zoned, with central potassic, medial phyllic, and distal propylitic zones. Late stage white mica, clay, and carbonate minerals are common (Cox, 1986d, Cox and others, 1995). Weathered porphyry Cu and porphyry Cu-Mo deposits are characterized by acid leaching, and widespread areas of iron and copper staining in the zone of oxidation, above the water table. Supergene chalcocite may become concentrated in the reduced zone, beneath the leached zone, and below the top of the water table.

Interpretation -- magmatic-hydrothermal stockworks, related to porphyritic stocks

Porphyry Cu-Mo deposits are interpreted as magmatic-hydrothermal deposits, developed within and around the upper parts of genetically related cupolas of porphyry stocks in areas of subduction-related magmatism. Ore-related porphyry tends to consist of phenocrysts in a fine- to medium-grained aplitic groundmass, indicative of rapid nucleation and crystallization, resulting from volatile release of magmatic-hydrothermal fluids, and pressure quenching of the aplitic groundmass. Ore-related porphyry stocks commonly are associated with abundant contemporaneous dikes, breccias, and stockwork veining indicative of forceful intrusion and explosive release of volatiles. During waning stages of mineralization and alteration, porphyry Cu-Mo magmatic-hydrothermal systems tend to collapse inward, and to be replaced by convecting groundwater, heated by the cooling igneous intrusion (Kirkham and Sinclair, 1996)

Examples

Table 1 and appendix B list three first-rank porphyry copper-molybdenum localities in the western PNF and vicinity. The IXL and Kismet porphyry copper-molybdenum prospects are in the Cuddy Mountains of the western PNF (fig. 14). They are small , low-grade porphyry-related copper-molybdenum prospects that are subeconomic under present and foreseeable market conditions. The Thorn Spring prospect, which is tentatively classified as a porphyry copper-molybdenum prospect, is in the Mineral district, west of the PNF.

IXL prospect: The IXL copper-molybdenum prospect is on the southwest side of Cuddy Mountain. Host rocks are porphyritic granodiorite and quartz diorite with large inclusions of metavolcanic rocks. Groundmass textures of the host intrusions are phaneritic, but the porphyritic granodiorite contains aplitic dikelets. Bruce (1971) mapped a roughly circular area of sericitized, mineralized rocks that measures about 1,500 ft (450 m) across at the surface, where chalcopyrite, molybdenite, pyrite, pyrrhotite, bornite, and magnetite occur in quartz veins, veinlets, breccias, and disseminations. Ore mineralogy is crudely zoned, with central chalcopyrite-molybdenite, intermediate chalcopyrite-pyrite, and outer pyrite-predominant zones. A well-mineralized fault breccia, approximately 100 ft (30 m) wide, was encountered in a 900-ft (237 m) exploration adit. The breccia matrix contains magnetite, chalcopyrite, molybdenite, and quartz (Bruce, 1971). Average grade for a 112 m section of the adit is 0.39 percent copper, with a 27 m interval that contains 0.01 to 0.1 percent molybdenum (USBM, 1996, p. A-80), which is economically marginal. Outside this mineralized fault-and-fracture zone, however, veinlet spacings are wide, and ore grades are economically sub-marginal. Geochemical anomalies for copper (70 to 300 ppm Cu) in panned concentrates of stream sediments from East Brownlee and Camp creeks, probably emanate from the IXL prospect area (K.C. Watts and H.D. King, unpub. data, 1997). The panned concentrate from East Brownlee Creek also contains moderately anomalous concentration of gold (0.013 to 0.94 ppm Au).

Kismet prospect: The Kismet copper-molybdenum prospect is on the east slope of the Cuddy Mountains, on the ridge between Hornet and Olive Creeks (in an area of state-owned land that lies within the PNF). At the Kismet prospect, a breccia pipe contains veinlets and disseminations of quartz, tourmaline, pyrite, chalcopyrite, molybdenite, and specular hematite. The breccia pipe cuts a small stock of Jurassic-Cretaceous porphyritic granodiorite, which intrudes a larger quartz-diorite stock that has a discontinuous gabbroic margin (Lund, unpub. data, 1997). The breccia contains fragments of veined and altered porphyritic granodiorite in a matrix of quartz, black tourmaline, feldspar, and(or) white mica, and disseminated ore minerals. The breccia pipe measures about 400 ft (121 m) northeast by 80 ft (24 m) northwest (Bruce, 1971, p. 125). Alteration-mineral assemblages grade outward from quartz-orthoclase-tourmaline in the core of the breccia, to intermediate quartz-white mica, to quartz-sericite-kaolinite on the margins of the breccia pipe, and peripheral chlorite-epidote. Drill core stored at the prospect contains weakly mineralized breccia and chloritized porphyritic granodiorite, cut by sparse veinlets. Bruce (1971) noted that drilling to 500 ft (152 m) encountered no supergene enrichment. A negative aeromagnetic anomaly (M.D. Kleinkopf and J.A. Pitkin, unpub. data) is centered on the Kismet prospect, where magnetic minerals have been destroyed by hydrothermal alteration. A geochemical anomaly for copper (70 to 300 ppm Cu) in panned concentrates from a sample of stream sediments from Hornet Creek probably derives from the Kismet prospect area.

A geochemical anomaly for copper (70 to 300 ppm) in panned concentrates from a sample of stream sediments from Business Creek may derive from the Kismet and (or) IXL prospect areas, or it may represent a separate center of copper mineralization.

Rationale for Tract Delineation

The entire PNF is permissive for porphyry copper-molybdenum deposits, since such deposits are related to porphyritic intrusions, which could be present almost anywhere in the subsurface of the Cordilleran tectonic province, which includes most of the western United States.

Favorable tracts for porphyry copper-molybdenum resources in the western PNF (fig. 14) were delineated on the basis of the distribution of Cu-Mo prospects, granodiorite to quartz diorite plutons (Karen Lund, unpub. data, 1997), and stream-sediment geochemical anomalies for copper (K.C. Watts and H.D. King, unpub. data, 1997). The favorable tract around the Kismet porphyry Cu-Mo prospect was extended to include a belt of negative magnetic anomalies, similar to the one that coincides with the prospect (Kleinkopf, M.D. and Pitkin, J.A., unpub. data, 1997). Copper skarns outside the favorable tract for porphyry Cu-Mo are considered peripheral manifestations of the IXL and Kismet porphyry Cu-Mo systems.

Although it contains copper skarns, the quartz diorite intrusion of the White Monument area is not considered favorable for porphyry Cu-Mo deposits. The intrusion is not porphyritic, and it lacks evidence of stockwork veining, pervasive phyllic to potassic alteration assemblages, or iron staining, typical of porphyry Cu-Mo systems.

Reason for no Numerical Estimation

No numerical estimation was done for undiscovered porphyry Cu-Mo deposits in the PNF, because the known deposits are too small to fit the USGS grade-tonnage models, and it is unlikely that undiscovered deposits are much larger.The highest-grade fault-controlled mineralization at the IXL prospect is similar to the median grade of the tonnage-grade model for porphyry copper deposits in British Columbia and Alaska. However, the IXL and Kismet prospects appear to be much too small too small to fit the tonnage models for either porphyry Cu-Mo or porphyry Cu deposits of British Columbia and Alaska.

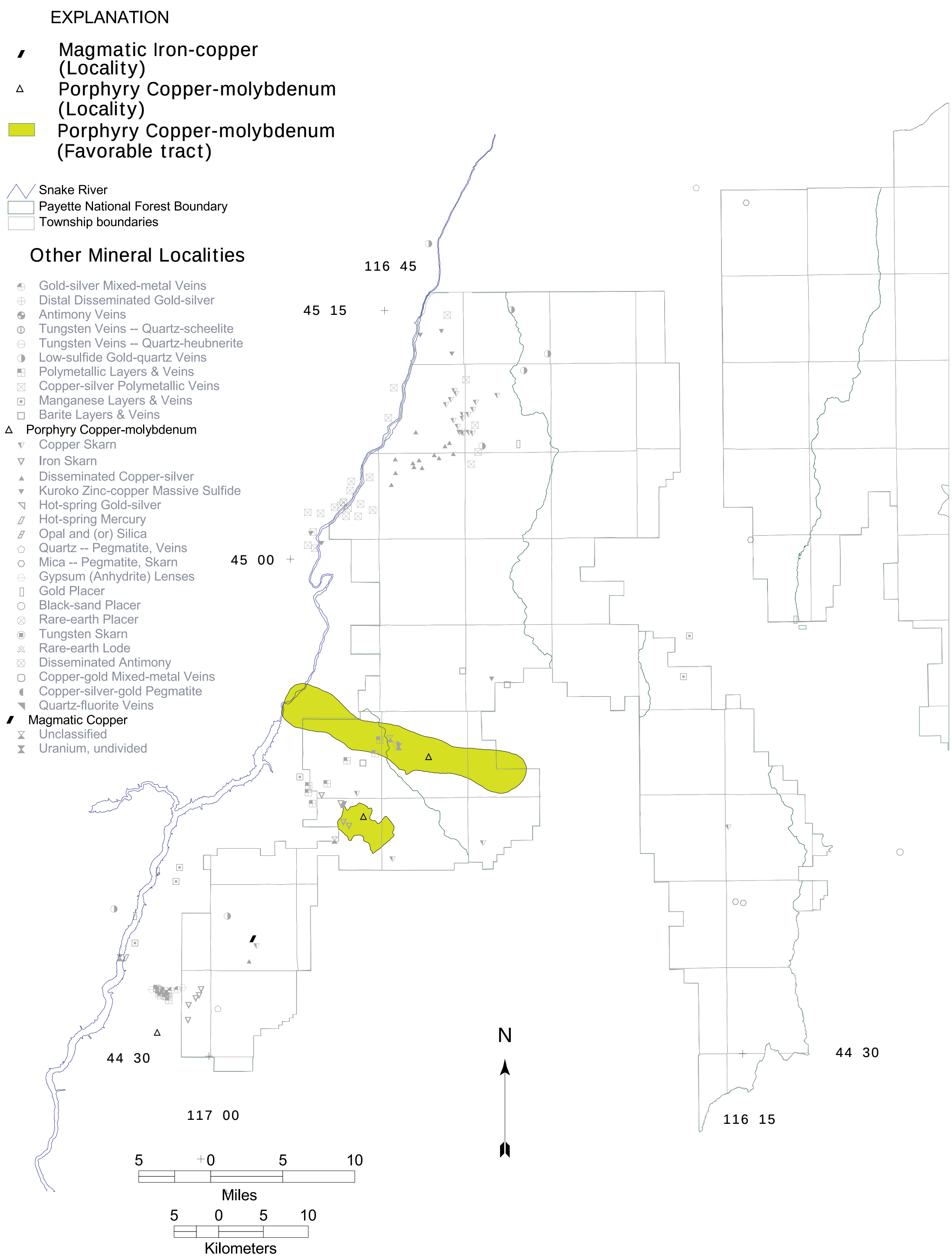


Figure 14. Map of localities and favorable tracts for Porphyry Copper-molybdenum; and a magmatic iron-copper locality, western PNF.

Except where covered by basalt, the favorable tracts are relatively well explored, and the team opinion was that the known prospects probably are representative of the undiscovered deposits. Therefore, no numerical estimates were made for probable resources of undiscovered porphyry copper-molybdenum deposits in the PNF, because use of the available tonnage-grade models would lead to overestimation of the potential resources.

Development Forecast

It is unlikely that porphyry copper-molybdenum occurrences of the Cuddy Mountains will be further explored or developed in the foreseeable future. It probably will be more economical to expand existing large open-pit copper-molybdenum mines elsewhere than to open small mines in the Cuddy Mountains area, which is geographically remote from other copper mines and copper processing facilities.

The presence of geochemically anomalous concentrations of gold in some drainages near the IXL prospect suggests that exploration for associated distal disseminated precious-metal deposits might be expected in the area if gold prices were to reach levels significantly above $350 / oz ($11.25 / g).

Environmental Effects and Implications

Elements present in porphyry Cu-Mo systems may be mobilized by chemical leaching, mechanical weathering, and erosional processes. Porphyry Cu-Mo systems are geochemically and minerallogically zoned. The extent to which various elements are released will depend on the erosional level of the deposit, and the relative abundances of acid-generating minerals, such as pyrite, the relative abundances of acid-buffering minerals, such as calcite, and the geochemical mobilities of elements. Although copper is geochemically mobile in acidic environments, molybdenum is relatively immobile in such environments.

Most porphyry Cu-Mo deposits are mined by open pit methods, and on average, about 1.5 tonnes of waste rock are removed for each tonne of ore. Deep, relatively high-grade deposits may be mined by block caving. Primary sulfide ore is pulverized, and sulfides are concentrated by froth flotation. Tailings from flotation mills are placed in tailings-settling ponds. Secondary oxide and supergene sulfide ores are acid-leached in place or in dumps of broken ore. Acid leaching removes copper, which is recovered from solution by solvent extraction and electrowinning (Cox and others, 1995).

Open pits, waste dumps, and tailings piles of mined porphyry Cu-Mo deposits are significant sources of particulate and dissolved metals that can have seriously harmful environmental effects. However, if no development occurs, the environmental effects of the IXL and Kismet porphyry Cu-Mo prospects will be minor, and restricted to those posed by existing exploration workings, and the weathering and erosion of exposed mineralized rocks. These are manifested by the moderately anomalous concentrations of copper in geochemical samples of stream sediments in East Brownlee, Camp, Hornet, and Business creeks.

Mineral Deposits in the Suture Zone

A broad zone of highly metamorphosed, steeply foliated and lineated rocks trends north-south along the west sides of Payette Lake and Cascade Reservoir. This zone is interpreted as a suture zone, along which oceanic terranes of the Blue Mountains Island Arc were accreted to the North American continent. The western part of this suture zone consists of schists and gneisses interpreted as highly deformed and metamorphosed rocks of deep levels of the oceanic Blue Mountains Island-arc terrane. The eastern part of the suture zone consists of gneissic to mylonitic intrusive igneous rocks (tonalite and granodiorite) of the western part of the Idaho Batholith, as well as local septa and pendants of metasedimentary rocks of the North American continental province (figs 4 and 5).

Few known bedrock-hosted mineral deposits are present within the suture zone. However, diamond, chromian garnet, corundum, and gold have been recovered from locally-derived alluvium deposited along the suture zone. The reported presence of diamond and rumored presence of chromian garnet in placers suggests that a bedrock source of diamonds may be present along the suture zone.

Diamonds
Deposit Code 040

USGS models -- Diamond placers, Diamond pipes, Diamond-bearing kimberlite

A USGS descriptive model (39d) for Diamond placers was written by Cox (1986f), who also wrote a USGS descriptive model (12) for Diamond pipes (Cox, 1986g). Michalski and Modreski (1991) wrote an expanded USGS descriptive model for Diamond-bearing kimberlites, which was followed by a USGS tonnage-grade model by Bliss (1992b). Mitchell (1993) presented a genetic model for kimberlites and lamproites as primary sources of diamond.

Description -- diamonds in placers, kimberlites and lamproites

Diamond placers can contain diamonds in alluvium, beach sediments, sandstone, or conglomerate (Cox, 1986f). Diamond placers are deposited in streams draining areas of kimberlite pipes or diamond concentrations in sedimentary or metamorphic rocks. Diamonds are concentrated with other heavy minerals in low-energy parts of stream systems. Diamonds decrease in size and increase in quality with distance from their source. Alluvial diamond deposits may be up to 1,000 km from their bedrock source of diamonds (Cox, 1986f).

Diamond-bearing kimberlites and lamproites are the principal hosts of primary diamonds. Kimberlites are rare, hybrid ultramafic rock. Kimberlite pipes are upward-flaring columns (diatremes) of volcaniclastic breccia with inclusions of various rock types from the mantle, lower crust and upper crust (Cox, 1968g). Lamproites are rare, uptrapotassic peralkaline rocks of intermediate composition with respect to their silica contents. The majority of lamproite diamond deposits are present in pryoclastic rocks, in which the diamonds are strongly resorbed (Mitchell, 1993). Kimberlite pipes are relatively small in diameter but vertically long. Lamproite vents tend to have larger diameters and shorter vertical lengths. Kimberlite pipes and Lamproite vents tend to form in elongate clusters along crustal lineaments.

Not all kimberlites and lamproites contain diamonds. Stream sediment sampling for diamond, Mg-ilmenite, Cr-pyrope (garnet) and Cr diopside is a commonly used technique for locating kimberlite pipes. The presence of placer diamonds in association with high-

Cr/low Ca garnet (pyrope) and chromite is indicative of diamond bearing kimberlite (Michalski and Modreski, 1991).

Interpretation -- diamonds in placer, possibly from local kimberlite or lamproite

The presence of diamonds in alluvium of a relatively minor drainage basin, like Rock Flats, suggests a local bedrock source for the diamonds. Kimberlite and lamproite pipes are the bedrock sources of most diamonds. Kimberlites and lamproites are magmas derived from the upper mantle, which may or may not contain xenocrystic diamonds. For a kimberlite or lamproite to contain diamonds, it must have picked up diamonds from the upper mantle, and transported them to the upper crust without complete oxidation or resorption (Mitchell, 1993). Kimberlites tend to form in continental areas of long-term tectonic stability, whereas lamproites tend to form along the margins of cratons or in cratonized accreted mobile belts in regions of thick crust and lithosphere (Mitchell, 1993). As these magmas approach the surface, they exsolve volatiles explosively to form kimberlitic breccia pipes and (or) lamproitic pyroclastic eruptions (Michalski and Modreski, 1991). Other mantle-derived rocks, such as serpentinites and continental flood basalts, may entrain diamond-bearing inclusions, but such diamonds are less likely to survive transport to the surface because of resorption, oxidation, or conversion to graphite.

Example -- lode exploration based on diamond-bearing placer

Rock Flat diamond-bearing placer: The Rock Flat placer area is along the south fork of Little Goose Creek, about 3 km northwest of McCall, and 10 km southeast of New Meadows (fig. 30). Three small diamond crystals were found in heavy concentrates of the Rock Flat placer from a testing operation on several cubic meters of gravel. “The largest of the diamonds was an almost perfect octahedron weighing one-third of a carat and having a grayish color and typically greasy luster. The angles were somewhat rounded with a fused appearance” (Shannon, 1926, p. 46). The rounded angles and fused appearance suggest partial resorption, typical of lamproite-hosted diamonds. Hausel (1995) described an unconfirmed 1947 report that a 19.5-carat diamond had been found in the same area. Diamonds also have been reported from gravel near Cascade, Idaho (Williams, 1964).

Rock Flat diamond-bearing kimberlite-lamproite prospect: The Rock Flat placer area and its surroundings were prospected for diamond-bearing kimberlite or lamproite by Golconda Gold, Inc., in joint venture with BHP Minerals during 1993-94. Chromian garnets, indicative of kimberlite, were rumored to have been found in placer concentrates from the Rock Flat area. In 1993 Golconda Gold, Inc. filed a Plan of Operations to drill several holes to test for diamond pipes in the Ecks Flat, Moorehead Flat, and Bear Basin areas, which surround the Rock Flat placer area. The western part of the prospect area is underlain by flat-lying Miocene basalt. The eastern part of the prospect area is underlain by steeply foliated tonalite of the Idaho Batholith. A rapid reconnaissance of the prospect area revealed no visual evidence of kimberlite or lamproite vents (A.A. Bookstrom, unpub. data, 1994).

Rationale for Tract Delineation

The suture zone (figs. 4 and 5) is considered permissive for diamond pipes and placers. It is a regional structural lineament, where placer diamonds have been found. Its tectonic setting would seem more favorable for the presence of lamproite than of kimberlite. However, the rumored presence of chromian garnets would seem indicative of kimberlite.

Reason for no Numerical Estimation

No numerical estimation was made, because insufficient information is available.

Development Forecast and Environmental Implications

Although diamond exploration may resume, it is unlikely that diamond pipes or placers will be developed in the next ten years in the PNF. Even if more diamonds were found, it would take a long time to determine whether the quality and amount are sufficient to support development. If no development occurs, the only environmental impact will be from possible additional exploration efforts and recreational gem prospecting activities.

Mineral Deposits of the Columbia River Basalt Province

The eastern margin of the Columbia River Basalt Province lies in the western PNF, where basalt flows of the Weiser Embayment of the Columbia River Basalt Province cover much of the Blue Mountains Volcanic-arc Accreted Terrane. Locally, basalt flows of the Weiser Embayment are interlayered and (or) overlain by fluvial and lacustrine sediments of the Payette and (or) Idaho Formations.

Hot-spring Mercury Deposits

deposit code 019

USGS model -- Hot-spring Hg deposits

Descriptive model 27a for Hot-spring Hg deposits (Rytuba, 1986a) is accompanied by a grade and tonnage model by Rytuba (1996b).

Description -- cinnabar disseminations and veinlets

Hot-spring Hg deposits near the western PNF contain cinnabar veinlets and disseminations in silicified clastic sedimentary rocks, interlayered with basalt flows. One prospect has cinnabar veinlets in phyllite that underlies basalt.

Interpretation -- hot-spring Hg deposits associated with basaltic volcanism

Hot-spring Hg deposits near the western PNF formed by veining and replacement of clastic sedimentary rocks by silica and cinnabar. This probably occurred near the paleo ground-water table of a shallow hot-spring system related to basaltic volcanism.

Examples

Idaho-Almaden mine: The Idaho-Almaden mine near Weiser, lies outside the PNF. Ore bodies are hosted in sandstone and shale of the Payette Formation of Miocene and Pliocene (?) age, which “have been converted to rock composed largely of chalcedony, or locally opal” (Bailey, 1964). Microcrystalline cinnabar is disseminated in the chalcedony and opal, coloring it pink. Coarser-grained cinnabar is in veins and veinlets.

Consolidated and John Coats prospects: The consolidated and John Coats prospects are north of the Idaho-Almaden mine but south of the PNF. They are geologically similar to the Idaho-Almaden deposit (Bailey, 1964).

Virginia L prospect: The Virginia L mercury prospect lies 6 km west of the southwest corner of PNF, where a short adit was driven on the east side of the Snake River to explore a zone containing veinlets of cinnabar in phyllite (Bailey, 1964).

Rationale for Tract Delineation

The Columbia River Basalt Province of the western PNF (fig. 5), plus a 10 km buffer zone around it, is considered permissive for Hot-spring Hg deposits related to basaltic volcanism in the Weiser Embayment of the Columbia River Basalt Province.

Reason for no Numerical Estimation

No hot-spring Hg deposits have yet been identified within the western PNF, and therefore no estimation was made of undiscovered resources of hot-spring Hg deposits in the western PNF.

LOCATABLE MINERAL RESOURCES, EASTERN PNF

Mineral Deposits of the North American Continental Province

In the eastern part of the PNF, metamorphic rocks of the Late Precambrian and (or) Early Paleozoic age belong to the North American Continental Province (or craton), to which the Blue Mountains Island Arc was accreted, and into which the Idaho Batholith was emplaced (figs. 4 and 5). Continental rocks of a relatively early stratigraphic sequence include metasedimentary biotite phyllite, schist, gneiss, marble, calc-silicate gneiss, and amphibolite gneiss of Middle Proterozoic age. Continental rocks of a relatively younger stratigraphic sequence include metasedimentary quartzite, conglomerate, biotite schist, marble, calc-silicate gneiss, metavolcanic amphibolite, and meta-rhyolite of Late Proterozoic to Early Paleozoic age (Karen Lund, unpub. data, 1997). These metamorphic rocks are intruded by syenite-diorite stocks of undetermined age, by the Atlanta lobe of the Idaho Batholith of Cretaceous age, and by stocks and dikes of Tertiary age. Volcanic and volcaniclastic rocks of Tertiary age locally overlie older metamorphic and intrusive igneous rocks.

Metamorphic, plutonic, and volcanic rocks of the North American Continental Terrane contain many types of mineral deposits, most of which are related to igneous-associated hydrothermal activity. Examples are copper-gold mixed-metal veins, gold-silver mixed-metal veins, mixed-metal skarn and hornfels deposits, distal disseminated gold-silver deposits, antimony veins, disseminated antimony deposits, tungsten veins, hot-spring gold-silver, and hot-spring mercury deposits.

Copper-gold Mixed-metal Veins
Deposit Code 033

USGS Model -- Mixed base- and precious-metal veins of the Idaho Batholith: Cu veins with coproduct Au, and byproduct Ag, Pb, and (or) Zn

Bliss (1994) presented a set of USGS tonnage-grade models for complex veins present within and around the Idaho Batholith, Idaho. The general model for Mixed Base- and Precious-Metal Veins of the Idaho Batholith, consists of six component models. Copper-gold mixed metal veins of the eastern PNF most-closely fit the component model for Cu veins with coproduct Au, and byproduct Ag, Pb, and(or) Zn.

Description -- quartz veins, prospected for Cu and Au

Copper-gold mixed-metal veins commonly contain quartz, chalcopyrite, magnetite, pyrite, minor galena, and sparse but valuable gold and silver. Chalcocite, malachite and oxides of iron and manganese are common weathering products. Assays range from trace to 17 wt percent copper, trace to 58 ppm gold, trace to 480 ppm silver, and trace to 60 wt percent iron. Relatively tabular veins are hosted in planar fractures in competent syenite-diorite, and (or) quartzite. Relatively irregular stringers and pods are hosted in incompetent phyllite.

Interpretation -- magmatic-hydrothermal veins, related to syenite-diorite stocks

Most copper-gold mixed metal veins of the eastern PNF are spatially, and probably genetically associated with porphyritic stocks of the syenite-diorite complex of Ramey Ridge (Karen Lund, unpub. data, 1997). Ages of these stocks have not been directly determined. They are compositionally similar to syenitic intrusions to the east, which have been isotopically dated as Ordovician in age (Karen Lund, unpub. data, 1997). However, they are also similar to intrusions of Eocene age, present to the south (Thor Kiilsgaard, pers. commun., 1998). In either case, these copper-gold mixed-metal veins probably are not genetically related to the Idaho Batholith, even though they are included in the tonnage-grade model for mixed base- and precious-metal veins of the Idaho Batholith.

Examples

Table 1 and appendix B list 77 first-rank, and 2 second-rank examples of copper-gold mixed-metal veins (figs. 15a and 15b). Most examples are prospects and occurrences, without recorded production. Most are in the Ramey Ridge and Big Creek mining districts, where they are hosted in porphyritic syenite-diorite stocks, and in surrounding quartzite and phyllite of the Yellowjacket Formation, of Middle Proterozoic age.

Golden Bear: The Golden Bear prospect is on the north side of Big Creek, between Little Ramey Creek and Crooked Creek. It is in the boundary zone between the Ramey Ridge and Big Creek mining districts, in the River of No Return Wilderness area (appendices A and B, and plate 1). The Golden Bear claims are located on quartz veins that are hosted in a syenite-diorite stock. According to Cater and others (1973), the quartz vein on the Golden Bear No. 1 claim strikes N. 65°-85° W. and dips 50°-80° NE. The vein averages 38 cm thick but pinches to 10 cm and swells to 1.5 m thick. Outcrops of the vein are iron and copper stained, and the vein contains chalcopyrite, pyrite, and traces of visible gold. Six samples from the vein averaged 20.6 ppm gold, 10.3 ppm silver, and 0.68 wt percent copper. Minor cobalt (0.03 wt percent) was reported in one sample of boxwork silica-limonite. Cater and others (1973) estimated that the vein contains at least 4,500 tonnes of submarginal resources, and it may contain more than 27,000 tonnes if the vein is continuous with vein outcrops across Carpenters Gulch.

Copper Camp: The Copper Camp prospect is in the Ramey Ridge mining district, in the River of No Return Wilderness Area (appendices A and B, and plate 1). At Copper Camp, the Black Bear vein occupies a shear zone in quartzite and argillite. The shear zone contains chalcopyrite, magnetite, pyrite, and chalcocite, "disseminated through crushed quartzite" (Shenon and Ross, 1936, p. 34). Several other veins in the area contain quartz, magnetite, chalcopyrite, and (or) pyrite. In general, assays indicated 1 to 4 wt percent copper, and 3 to 31 ppm gold.

Rationale for Tract Delineation

The PNF east of 115º west longitude is considered permissive for Cu-Au mixed-metal veins, which are related to syenite-diorite intrusions of unknown age, which could be present in the subsurface almost anywhere in the eastern PNF. Favorable tracts for copper-gold veins are defined by the distribution of known veins of this type, by copper geochemical anomaly patterns, and by magnetic anomaly patterns interpreted to represent the subsurface extent of syenite-diorite, with which the veins appear to be associated (figs 15a, 15b). The eastern PNF has been well explored for copper-gold mixed-metal veins, as indicated by the exploration history displayed in table 4.

Figure 22a shows a Cu-bearing mixed-metal skarn that lies within the favorable tract for Cu-Au mixed-metal veins. That copper-bearing skarn is associated with Cu-Au mixed-metal veins, related to the syenite-diorite complex of Ramey Ridge. Also present in the favorable tracts for Cu-Au mixed-metal veins are two Au-Ag mixed-metal vein prospects, one vein barite prospect, and many gold placer deposits. The geology of the favorable tracts also is permissive for Fe skarn, Au-bearing skarn, porphyry copper, and distal-disseminated gold-silver deposits, but no evidence indicates their presence.

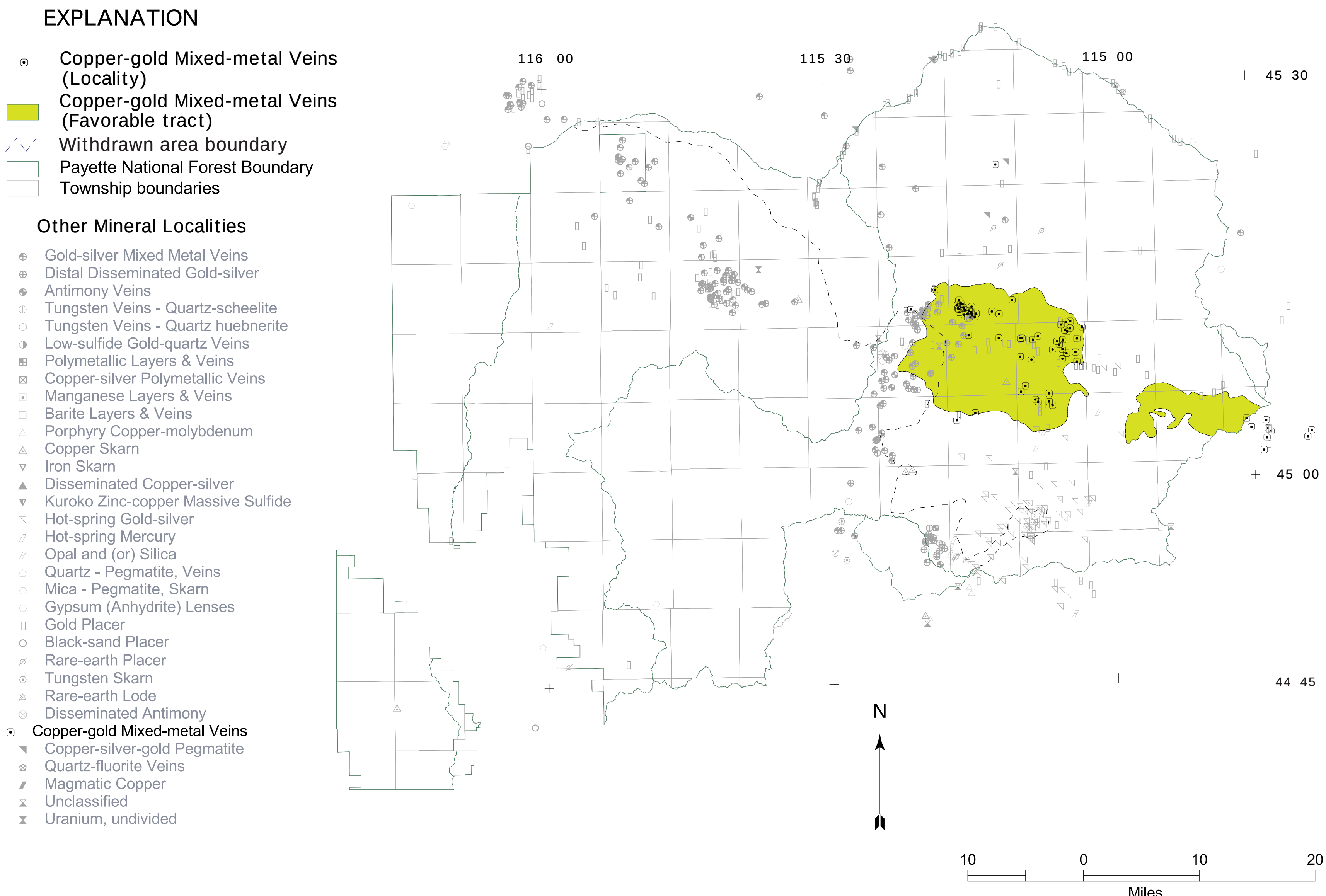


Figure 15a. Map showing favorable tracts for Copper-gold Mixed-metal Veins, and localities with Copper-gold Mixed-metal veins as first-rank components, eastern PNF.

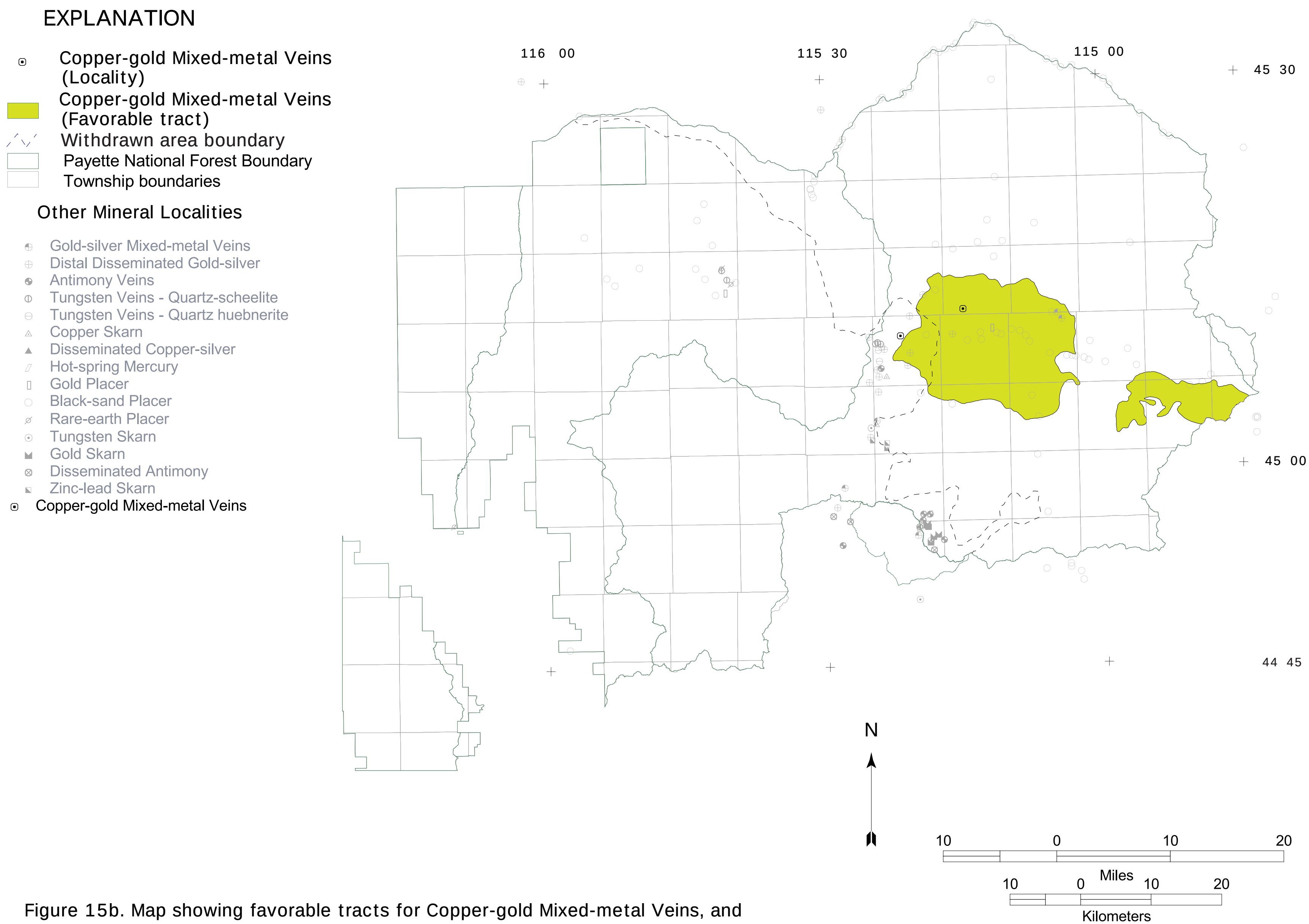


Figure 15b. Map showing favorable tracts for Copper-gold Mixed-metal Veins, and localities with Copper-gold Mixed-metal veins as second-rank components, eastern PNF.

Reason for no Numerical Estimation

Undiscovered copper-gold veins may exist, but they probably are not economically significant, and they probably are located mostly in the Frank Church - River of No Return Wilderness area, which is closed to mineral entry. Therefore no numerical estimation was made for undiscovered copper-gold veins.

Development Forecast and Environmental Implications

Most copper-gold veins are located in the Frank Church - River of No Return Wilderness Area, where it is unlikely that development will be allowed. Nevertheless, a court decision against development of the Golden Bear vein, on Little Ramey Creek, is being appealed (J.D. Egnew, oral commun., 1997).

Wastes from copper-gold mines and mills will tend to interact with surface and oxidizing groundwater to produce acidic, metal-enriched mine-drainage waters. However, the mines and waste piles are small, and natural dilution should limit environmental effects to small areas.

Vein Barite

deposit code 012

USGS Model -- Vein barite

USGS descriptive model for vein barite (model 27e) by Clark and Orris (1991) is accompanied by a grade and tonnage model of barite veins by Orris (1992b).

Example -- description, interpretation, implications

One occurrence of vein barite is present in the eastern PNF, in the Big Creek mining district. It is a barite-bearing vein that cuts Precambrian metasedimentary rocks and contains chalcopyrite and malachite. It is interpreted as a magmatic-hydrothermal baritic copper vein, probably akin to nearby copper-gold mixed-metal veins, related to porphyritic stocks of the syenite-diorite complex of Ramey Ridge.

This one reported occurrence of vein barite in the eastern PNF was not considered sufficient to warrant delineation of permissive or favorable tracts, or to support estimation of undiscovered resources of such deposits in the eastern PNF. Furthermore, it is considered very unlikely that the identified occurrence of vein barite will be developed, because it is in the Frank Church - River of No Return Wilderness Area. The deposit is small, and if not developed, its environmental impact will be negligible.

Mineral Deposits of the Idaho Batholith and Vicinity

The Idaho Batholith, which underlies much of central Idaho, is a regional composite igneous intrusive body of Late Cretaceous age. It is about 240 mi (380 km) long (north-south) and about 10 to 100 mi (16 to 160) km wide. It is divided into the northern Bitterroot Lobe and the southern Atlanta Lobe. The PNF is located near the northern end of the southern Atlanta Lobe of the Idaho Batholith.

In the PNF, the Atlanta Lobe of the Idaho Batholith consists predominantly of granodiorite, with tonalite along its western margin, and subordinate exposures of late two-mica granite stocks near its northern and eastern margins. The western margin of the batholith lies along the suture zone between continental and accreted oceanic terranes, where metamorphic minerals and fabrics indicate relatively deep levels of geobarometry and exposure. The eastern margin of the batholith is irregularly shaped, and is bounded by a variety of rock types, including older metasedimentary rocks, igneous intrusive rocks of various ages, and younger Tertiary volcanic rocks (fig. 5). Toward the north and east margins of the Atlanta Lobe exposures of late granite, aplite and pegmatite, and inclusions or pendants of metasedimentary rocks are relatively common. Hydrothermal mineral deposits also are relatively common in the northern and eastern margins of the Atlanta Lobe, which apparently have been less deeply eroded than most of the rest of the Idaho Batholith in the PNF.

Clusters of gold-silver mixed-metal veins are localized in the Marshall Lake and Warren mining districts. Other groups of gold-silver mixed-metal veins, mixed-metal skarn and hornfels, distal disseminated gold-silver deposits, stibnite veins, disseminated stibnite deposits, and tungsten veins are localized in the Edwardsburg, Profile Gap, and Yellow Pine districts. Green (1972) suggested that these districts lie along roughly linear mineral belts: the Stibnite - Florence belt, which trends northwest, through the Warren and Marshall Lake districts; and the Thunder Mountain - Dixie belt, which trends north-northwest, along the east margin of the Idaho Batholith, through the Yellow Pine, Profile, and Edwardsburg districts.

Gold-silver Mixed-metal veins

deposit code 001

USGS model -- Mixed base- and precious-metal veins of the Idaho Batholith: Au veins with byproduct Ag, Cu, Pb, and (or) Zn

Bliss (1994) presented a set of USGS tonnage-grade models for complex veins present within and around the Idaho Batholith, Idaho. The general model for Mixed Base- and Precious-Metal Veins of the Idaho Batholith, consists of six component models. Gold-silver mixed-metal veins of the eastern PNF most-closely fit the component model for Au veins with byproduct Ag, Cu, Pb, and(or) Zn.

Description -- multi-stage quartz veins with minor amounts of various ore minerals

Gold-silver mixed-metal veins are quartz-rich, mixed base- and precious-metal veins. They generally contain about 5 vol percent or less of a wide variety of ore minerals, which commonly are present as fine-grained disseminations, streaks and pods. Arsenopyrite, pyrite, galena, sphalerite, chalcopyrite, tetrahedrite, and stibnite are common. Bournonite, proustite, argentite, electrum, and gold are sparse to rare. Some gold-silver veins contain heubnerite, and some contain scheelite. The following minerals also have been reported as minor to rare constituents of some gold-silver mixed-metal veins: pyrrhotite, marcasite, molybdenite, acanthite, digenite, miargyrite, hessite, cinnabar, zinc-mercury sulfides, and (or) unidentified uranium minerals (appendix B, Shenon and Ross, 1936; Reed, 1937; Leonard, 1965; Leonard and others, 1967; Kirkpatrick, 1975; May, 1984; Gammons, 1988).

Compositions and textures of gold-silver mixed-metal veins generally indicate repeated episodes of fracturing and healing by multiple generations of quartz with different associations of ore minerals. As determined by Gammons (1988), mean $^{40}Ar/^{39}Ar$ ages on muscovite from veins from the Big Creek, Edwardsburg, and Yellow Pine districts indicate deposition of vein-mineral assemblages of Stages I to VI, from 79 to 53 Ma, as follows:

Stage I: quartz + pyrite ± arsenopyrite, Au (79 to 77 Ma);
Stage II: quartz + stibnite ± Ag and (or) Au (< 77 to > 74 Ma);
Stage III: quartz + base-metal sulfides, sulfosalts, huebnerite or scheelite, and (or) electrum (74 Ma);
Stage IV: quartz + siderite ± rhodochrosite, pyrite, marcasite, base-metal sulfides, sulfosalts, tellurides, and (or) electrum (69 Ma);
Stage V: quartz + scheelite (57 to 53 Ma);
Stage VI: clear, vuggy quartz ± dolomite, barite, base-metal sulfides, lead-silver sulfosalts, electrum, stibnite, cinnabar, and (or) zinc-mercury sulfides (< 53 Ma).

Mixed-metal veins can contain any combination of the paragenetic-stage mineral assemblages listed above, depending on where they were located with respect to various hydrothermal systems that operated in the region during the long time interval from 79 to < 53 Ma, and whether they were opened or sealed during a particular stage of mineralization.

Gammons (1988) reported evidence of boiling in fluid inclusions of stages II to V, but not in fluid inclusions of stage VI. For fluid inclusions of stages II to VI, he reported the following mean salinities, mean homogenization temperatures, and trapping pressures (based on CO_2 homogenization behavior).

Stage II: 3.4 wt percent $NaCl_{equivalent}$ at 275°C, and 1,300 to 1,600 bars
Stage III: 4.1 wt percent $NaCl_{equivalent}$ at 255°C, and 1,300 to 1,600 bars
Stage IV: 2.0 wt percent $NaCl_{equivalent}$ at 338°C, and 150 to 450 bars
Stage V: 2.4 wt percent $NaCl_{equivalent}$ at 267°C, and 150 to 450 bars
Stage VI: 2.0 wt percent $NaCl_{equivalent}$ at 303°C.

These data indicate low salinities, mesothermal temperatures, and boiling under pressures that decreased from 1,450 ± 150 bars for stages II and III to 300 ± 150 bars for stages IV and V.

Interpretation -- veining of stages I to IV related to two-mica granite of the Idaho Batholith ± post-batholith veining of stages V and VI

Minerals of vein-forming stages I to IV (79 to 69 Ma) are interpreted as depositional products of dilute mesothermal fluids related to late two-mica granite of the Idaho Batholith (dated 78 to 72 Ma by Lewis and others, 1987). Although outcropping plutons of two-mica granite are relatively unmineralized, it is inferred that veining of stages I to IV occurred along fractures above subjacent portions of large, coeval plutons of two-mica granite that were episodically emplaced, crystallized, and cooled during the time interval of that mineralization (79 to 69 Ma). The drop in fluid-inclusion trapping pressures from 1,450 bars at stage III to 300 bars stage IV suggests that major uplift, erosion, and unroofing of the magmatic-hydrothermal system occurred between 74 and 69 Ma.

Scheelite of stage V (dated 57 to 53 Ma) is younger than late two-mica granite of the Idaho Batholith, but older than porphyritic intrusions and volcanic rocks of the Eocene magmatic complex, dated 51 to 39 Ma (Lund, unpub. data, 1987). Stage V scheelite may be related to very late, unexposed, probably granitic plutons emplaced into the Idaho Batholith at depth, and (or) to long-lived circulation of post-magmatic hydrothermal fluids, associated with slow cooling of the very large mass of the Idaho Batholith.

Early Tertiary (Eocene) intrusions of the eastern PNF appear to be relatively unmineralized and unaltered. Swarms of dikes of relatively unaltered dacite to rhyolite porphyry cut veined, silicified, sericitized plutonic and metasedimentary rocks in and around the eastern part of the Idaho Batholith. Minor mineralized pegmatites, quartz-fluorite veins, and a few widely spaced polymetallic quartz veins are associated with the large Eocene pluton of hornblende-biotite granite of Chamberlain Basin, dated 48 Ma by Leonard and Marvin (1982).

Mineral assemblages of stage VI (<53 Ma) resemble those of epithermal hot-spring Au-Ag and hot-spring Hg deposits associated with the Eocene Thunder Mountain Caldera (48 to 43 Ma, according to Leonard and Marvin, 1982, and Adams, 1985). However, the high mean homogenization temperature (303^{o}C) reported by Gammons (1988) for stage VI veins, indicates that stage VI mineralization was mesothermal, not epithermal.

Examples

Table 2 and appendix B list 149 first-rank, and 3 second-rank gold-silver mixed-metal veins, the locations of which are indicated on figures 16a and 16b. Clusters of gold-silver mixed-metal veins are present in the Marshall Lake, Warren, Edwardsburg, Profile and Yellow Pine mining districts. A few examples also are present in the Ramey Ridge and Big Creek districts. The Marshall Lake and Warren districts lie along the northwest-trending Florence-Stibnite mineral belt of Green (1972). The Edwardsburg, Profile and Yellow Pine districts are located within the relatively wide, north-northwest trending Dixie-Thunder Mountain mineral belt, which straddles the eastern margin of the Idaho Batholith.

Marshall Lake district: Gold-silver mixed-metal veins of the Marshall Lake district are in north-central part of the Atlanta Lobe of the Idaho Batholith, and are hosted in Cretaceous biotite-muscovite granite and foliated granodiorite, and in roof pendants and inclusions of metasedimentary quartzite, biotite-sillimanite-garnet schist, calc-silicate rock, and marble of Middle Proterozoic to Paleozoic age(s). The veins strike west-northwest and dip 45 to 70^{o} southwest, and commonly are 25 to 60 cm thick, but pinch and swell from 0 to 1.2 m thick (May, 1984). They typically are composed mostly of white to iron-stained quartz that is mostly massive but locally vuggy. Ore minerals are either dispersed throughout the quartz, concentrated in thin bands, or localized in vugs. Forrester (1940) described the following order of mineral deposition: quartz, galena, sphalerite, tetrahedrite, pyrite, argentite, tourmaline, siderite, hematite, and free gold. Gold and silver are erratically distributed, and there is no extensive secondary enrichment. Examples are the Old Kentuck (Hacket), Sherman Howe, Golden Anchor, Kimberly, Fisher and Gold Crest, Hinkson-Bishop (Leadville),Wilcox, Mount Marshall, Tuttle, Hyatt, Gertrude, Blue Bucket (Gold Run), and Alberta mines and prospects (Forrester, 1940; Murray, 1979; May, 1984; U.S. Bureau of Mines, 1996). These veins commonly have sharp walls, with only minor silicic, sericitic, and propylitic (chlorite-clay) alteration of adjacent wall rocks.

Warren district: About 40 gold-silver mixed-metal veins are known in the Warren district , which extends to the southeast of the Marshall Lake district. Most of these veins strike N. 90^{o} $\pm$ 20^{o} E. and dip 70^{o} $\pm$ 20^{o} south (Reed, 1937). The veins are lenticular, with strike length up to about 1,000 m and thickness commonly in the range of 30 to 60 cm. The Unity mine was developed on a set of 8 parallel veins, including the Rescue vein, which also was mined in the Rescue and Goodenough mines. The Rescue vein has been traced through a vertical range of about 200 m (Reed, 1937), and has been mined from the Rescue decline since 1992. The vein consists of lenses of quartz in a matrix of gray fault gouge. Slickensides plunge nearly parallel to the dip of the fault. The vein contains white- and gray-banded quartz, and later white, vuggy quartz. The gray-banded quartz contains fine-grained disseminated ore minerals such as pyrite, galena, sphalerite and electrum. Minor tetrahedrite, arsenopyrite, argentite, and tellurides also have been reported in veins of the Warren district (Reed, 1937). The veins are hosted in Late Cretaceous porphyritic muscovite-biotite granite of the Idaho Batholith. The veins have narrow alteration envelopes in which sericite along the vein walls grades outward to chlorite, which grades outward to unaltered granite. At the surface, vein quartz and sericitized wall rock commonly are limonite-stained. Examples of gold veins with byproduct silver, lead, zinc and copper in the Warren district are the Arlise, Charity, Delaware, Dewey, Gayety, Goodenough, Hornet, Iola, Knott, Little Giant, Lucky Ben, Minnehaha, Mohawk, Monitor, New Era, Rainier, Rescue, Silver King, Silver Monarch, Summit, and many unnamed veins.

Edwardsburg district: From north to south, examples of gold-silver mixed-metal veins in the Edwardsburg mining district include veins of the Golden Hand, Werdenhoff, and Golden Cup mine areas (which are in west half of the Big Creek 7.5’ quadrangle); the McCrae-Red Bluff and Independence-Fawn Meadow areas, and the Antimony Rainbow area (which are in the southeast quarter of the Wolf Fang Peak 7.5’ quadrangle); the Fourth of July and Sunday mines, and the Moscow mine area (which are in the northeast quarter of the Profile Gap 7.5’ quadrangle).

Profile district: Examples of mixed base- and precious-metal veins in the Profile mining district include veins of the B and B prospect, the Wilson and Glasgow mine areas, and the Red Metals mine area (which are in the southeast quarter of the Profile Gap 7.5’ quadrangle).

Yellow Pine district: Examples of mixed base- and precious-metal veins are sparsely distributed in most of the Yellow Pine district, but are prominently associated with distal disseminated gold-silver deposits in the Stibnite subdistrict, which is in the southeast part of the Yellow Pine district.

Gold-silver mixed-metal veins in the Edwardsburg, Profile and Yellow Pine districts are distributed along and near the east margin of the Idaho Batholith. Many are in or near roof pendants or inclusions of metasedimentary rocks. Many are localized along faults and fractures that strike north to northeast and dip steeply. Gently-plunging slickensides are common, and northeast-striking vein jogs and splays tend to be relatively widely broken and mineralized. This indicates that north-striking veins formed along right-lateral strike-slip faults with northeast-striking dilational jogs and splays.

Gold-silver mixed-metal veins of the eastern margin of the batholith commonly have wide silica-sericite alteration envelopes that contain disseminated pyrite and arsenopyrite. These grade outward to sericitized rock, surrounded by propylitized rock that contains chlorite and clay minerals. Alteration of this type is restricted to rocks of Cretaceous and older ages. Eocene porphyries of a swarm of north-trending dikes generally do not contain veins and are relatively unaltered. Direct cross-cutting relationships between veins and dikes are rare however, because most of the dikes strike and dip parallel to the veins.

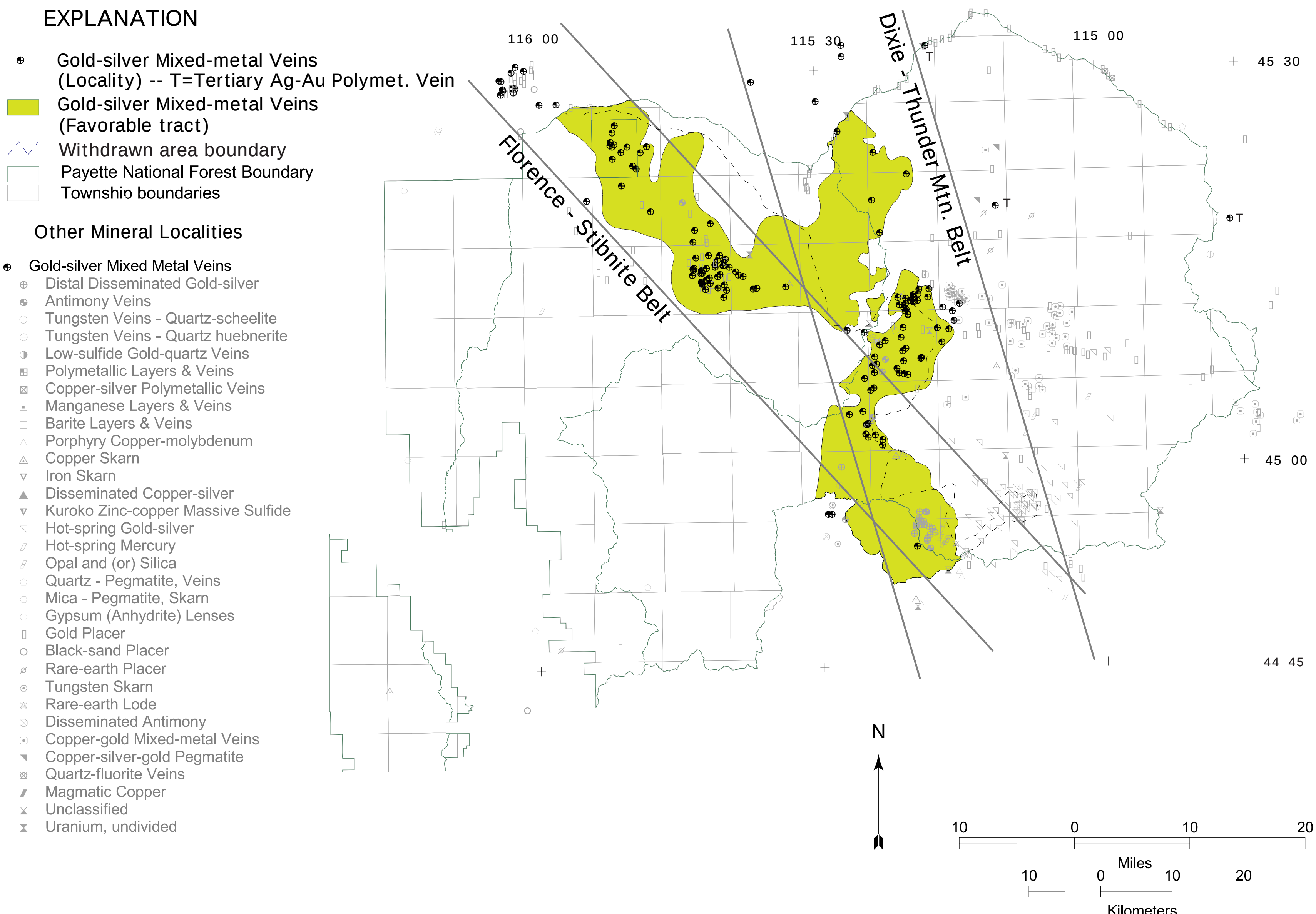


Figure 16a. Map showing favorable tracts for Gold-silver Mixed-metal Veins, and localities with Gold-silver Mixed-metal veins as first-rank components, eastern PNF. Most are associated with Late Cretaceous two-mica granite of the Idaho Batholith, but three (labeled T) are related to the Tertiary syenogranite stock of Chamberlain Basin, and are alternatively classified as Silver-gold Polymetallic Veins (appendix B).

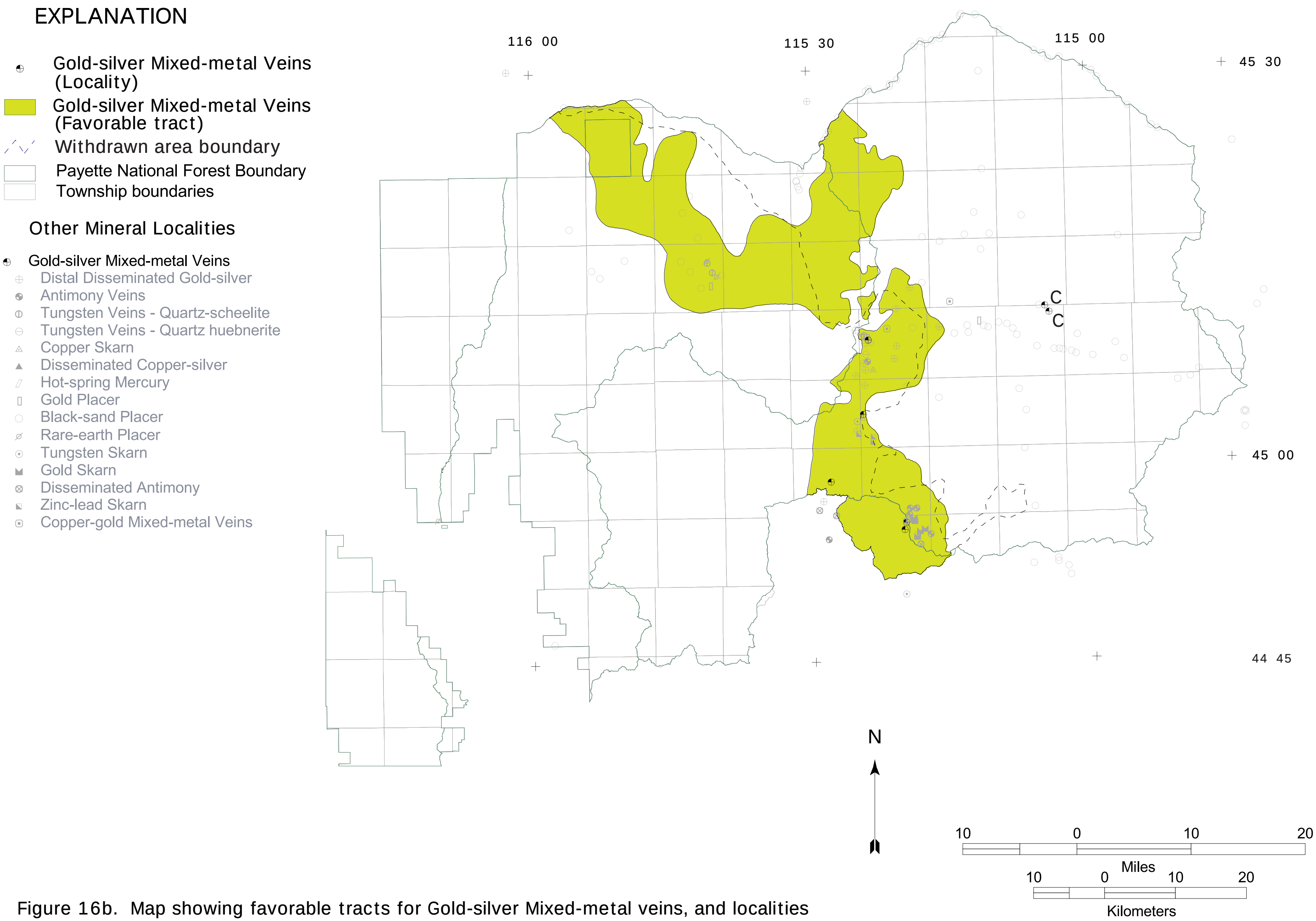


Figure 16b. Map showing favorable tracts for Gold-silver Mixed-metal veins, and localities with Gold-silver Mixed-metal veins as second-rank components, eastern PNF. Localities labeled C are alternatively classified as first-rank Copper-gold Mixed-metal veins (appendix B).

Rationale for Tract Delineation

The Idaho Batholith (fig. 5) and a 10-km buffer zone around it are considered permissive for gold-silver mixed-metal veins. Favorable tracts for gold-silver mixed-metal veins are shown on figures 16a and 16b. In general a northern tract includes and connects the Marshall Lake and Warren districts (of the Florence - Stibnite mineral belt). A southern tract contains and connects the Edwardsburg, Profile, and Yellow Pine districts (of the Dixie - Thunder Mountain mineral belt). Tertiary intrusions between the two tracts are excluded, because they are mostly post-ore in age, and mostly unmineralized.

Associated deposit types include mixed-metal skarn and hornfels, distal disseminated gold-silver, antimony veins, disseminated antimony, tungsten veins, and gold placer deposits. The geology of the tract may also be permissive for the presence of porphyry copper-molybdenum deposits. However, we recognized no positive evidence for their existence within the eastern PNF.

Rationale for Numerical Estimation

Bliss (1994) developed a set of tonnage-grade models for mixed base- and precious-metal veins of the Idaho Batholith. He invented mineral-deposit component modeling, in order to accommodate variable combinations of components. In this modeling system, a metal is considered primary if it contributed more than 75 percent of the value of the ore produced. Metals are coproducts when their summed value is greater than 75 percent. Other metals that contribute less are by-products. The set of tonnage-grade models for mixed base- and precious-metal veins includes data from 48 deposits, most of which (79 percent) can be characterized using only one component. Gold veins are the most common component, found in 73 percent of the deposits. Silver is the most common coproduct or byproduct, but base-metal coproducts and byproducts also are reported. Tungsten, arsenic and antimony also are reported as byproducts of gold veins (Bliss, 1994, p 10).

One problem with modeling of mixed base- and precious-metal vein deposits is that mines commonly access multiple veins, and production data are generally available for mines, but not for individual veins. Thus, for the purposes of tonnage and grade modeling, a “deposit” is defined to include all adjacent veins within one mile (1.6 km) or less. Extensions of known veins, and veins that are closer than 1.6 km to a vein with identified resources, are properly classified as extensions of identified resources, which should not be included in the estimation of undiscovered resources, because the model would tend to over-estimate their resources. This must be recognized when the models are used to estimate resources of undiscovered deposits, and when the estimates are used for any purpose.

The Bliss (1994) tonnage model for mixed base- and precious-metal veins was used for estimation of the tonnage of ore in undiscovered gold-silver mixed-metal veins. That 48-deposit set has a geometric mean size of 13,000 tonnes, which is independent of the number of components. For estimation of gold grade, the gold-vein component of the model was used. That 34-deposit set has a median grade of 13 ppm gold (with 10 percent lower than 2.3 ppm, and ten percent higher than 68 ppm). For estimation of silver grade, the 38-deposit byproduct silver component model was used.

Table 8. Gold-silver Mixed-metal Veins: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Gold-silver Mixed-metal Veins (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	2	3	5	7	9

Mark 3 output

Estimate of probability of 0 deposits: 3.9%

Estimate of probability of the median number of deposits (3): 30%

Estimate of mean expected number of deposits: 3.4

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Gold-silver Mixed-metal Veins (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
gold	0.13	0.96	4.2	2	28%
silver	0	0.058	1.0	0.42	22%
ore	9,300	59,000	270,000	110,000	38%

Estimation of numbers of undiscovered deposits was done by counting targets, and considering the favorability of their attributes. Exploration history, deposit spacing, and amount of cover also were considered. Then subjective estimates were made of how many targets are likely to fit between the 10th and 90th percentiles of the tonnage and grade models for gold as a primary component, and silver as a by-product of gold-silver mixed-metal veins. This was done for a range of levels of subjective probability. For the 90th, 50th, 10th, 5th, and 1st percentiles of subjective probability, the team estimated 2, 3, 5, 7, and 9 undiscovered deposits consistent with the tonnage and grade models of Bliss (1994). Results of the estimation of undiscovered resources in gold-silver mixed-metal veins are summarized in table 8.

Development Forecast

Gold-silver mixed-metal vein mines were shut down during World War II, and have never fully recovered. In the Warren district, the Rescue decline was driven in 1992-94 to mine the downward extension of the Rescue vein, and a small mill has been assembled and operated. However, recent attempts to reopen the Unity mine have been unsuccessful, because of a major cave-in, which reactivates when it is disturbed by efforts to clear it. In the Marshall Lake district, the Alberta mine was the site of a small open-cut mining and milling operation in 1993, and interest was shown again in 1997 (J.D. Egnew, oral commun., 1997). In the Edwardsburg district, small-scale mining and milling operations have been active between 1992 and 1997 at the Werdenhoff mine and the Fourth of July mine.

Gold-silver mixed-metal veins of the Idaho Batholith are a favorite target for miners of small-scale deposits, but are of little interest to large companies (unless they are associated with large tonnages of bulk-mineable ore). In 1996, a proposed plan of operations was submitted to explore the Golden Hand mine area, which is on National Forest System land in the Frank Church River of No Return Wilderness. The proposal by American Independence Mines and Minerals of Big Creek Idaho, was to reconstruct 2.7 mi of existing road, do 750 ft of trenching, re-open mine workings, and drill 50 exploration holes (David Alexander, written commun., 1996). Requests for similar types of activity can be expected to continue in the favorable tract for gold-silver mixed-metal veins, as long as gold is priced above about $10 per gram ($ 311 per troy ounce).

Environmental Effects and Implications

Environmental implications of small-scale mining of mixed base- and precious-metal veins with relatively low contents of ore minerals are relatively local and minor. The size of the area with mines has a median of 2.9 km^2, and 80 percent of the areas with mines are larger than 0.36 km^2, but smaller than 23 km^2. Mine-waste dumps are likely to have relatively low sulfide content, and mine drainage waters are not likely to be strongly acidic, or to have high contents of dissolved metals. Water draining from the Rescue decline in September of 1994 had a pH of 7.7. It contained 160 ppb of arsenic (well below the Idaho in-stream standard of 1,900 ppb arsenic), and less than 10 ppb of zinc, copper, cadmium, cobalt, nickel, lead, or uranium.

Miners of small mixed base- and precious-metal veins typically mill their ores at or near their mine sites to produce concentrates for shipment to smelters. They commonly use jigs, shaker tables, and (or) spirals to separate high-density ore minerals from low-density gangue minerals. Alternatively they may use selective flotation to concentrate sulfide minerals. Cyanidation may also be used to remove gold from oxidized ore that may contain free gold that has been liberated from sulfides by weathering. Flotation reagents and cyanide must not be released to the environment, and settling ponds are required to prevent siltation of stream beds by the pulverized rock of mill tailings. Other possible environmental effects include road building and truck traffic.

Mixed-metal Skarn and Hornfels

deposit codes

Cu skarn 014, Zn-Pb skarn 032, Au-bearing skarn 030, W skarn 027

USGS models -- Cu skarn, Zn-Pb skarn, Fe skarn, Au-bearing skarns, W skarn

USGS descriptive models are available for Cu skarn (model 18b, Cox and Theodore, 1986), W skarn (model 14a, Cox, 1986h), Au-bearing skarns (Theodore and others, 1991), Zn-Pb skarn (model 18c, Cox, 1986i), and Fe skarn (model 18d, Cox, 1986c). USGS grade and tonnage models are available for Cu skarn (Jones and Menzie, 1986a), W skarn (Menzie and Jones, 1986), and Zn-Pb skarn (Mosier, 1986), but not for Au-bearing skarns.

Description -- mixed-metal skarn and hornfels in metasedimentary rocks, within and around the Idaho Batholith

Mixed-metal skarn- and (or) hornfels-bearing prospects and occurrences of the eastern PNF are hosted in metasedimentary rocks within and around the Idaho Batholith. In figures 22a and 22b and appendix B "skarn" refers to both coarsely crystalline skarn and fine-grained hornfels. Most mixed-metal skarn- and (or) hornfels-bearing prospects of the eastern PNF are second-, or third-rank components, associated with first-rank mixed-metal veins of the Idaho Batholith, distal disseminated Au-Ag deposits, and (or) tungsten veins (appendix B, and figs. 17a, 17b). Individual mixed-metal skarn- and (or) hornfels-bearing prospects and occurrences are classified according to their predominant metals, as in USGS models for Cu, Zn-Pb, Fe, Au-bearing, and (or) W skarns.

Ore-mineral assemblages of mixed-metal skarn- and (or) hornfels-bearing prospects and occurrences of the eastern PNF are similar to those of associated mixed-metal veins of the Idaho Batholith, distal disseminated Au-Ag deposits, and (or) tungsten veins. However, the calc-silicate-bearing skarn- and (or) hornfels-bearing components are more stratigraphically restricted, and tend to be more irregularly shaped than the veins.

Gammons (1988) studied fluid inclusions in massive garnet-diopside wollastonite skarn at Logan Mountain, between Edwardsburg and Profile Gap (probably at the Logan Copper Hill Prospect, where an antimony vein is superimposed on a copper-bearing skarn). He found many generations of fluid inclusions in quartz, most of which were rich in CO_2, and showed evidence of boiling. Homogenization temperatures of the trapped fluids ranged from 300 to 190°C, and fluid salinities ranged from 15.7 to 0.0 wt percent $NaCl_{equivalent}$..

Interpretation -- mixed-metal skarn and hornfels associated with mixed-metal veins of the Idaho Batholith

Mixed-metal skarn- and (or) hornfels-bearing prospects and occurrences of the eastern PNF are interpreted as products of batholith-related thermal metamorphism, replacement, and veining of calcium- and (or) carbonate-bearing host rocks. As in mixed-metal veins of the Idaho batholith, mineralization of stages I to IV was coeval with and genetically associated with late two-mica granite of the Idaho Batholith. Tungsten mineralization of stage V was later than exposed parts of the batholith, but earlier than Tertiary magmatism in the eastern PNF.

Examples

Cu-bearing mixed-metal skarns: Copper-bearing mixed-metal skarn is present at the Benson occurrence in the Warren district, the Missouri Creek prospect and the Copper Cliff occurrence in the Edwardsburg district, and the Wild Horse prospect in the Big Creek district. Copper-bearing skarn is associated with tungsten-bearing skarn at the Profile Gap prospect in the Profile district, and with antimony veins at the Logan Copper Hill prospect in the Big Creek district. Copper-bearing skarn is associated with gold-silver mixed-metal veins and zinc-lead-bearing skarn at the Ryan Creek prospect in the Edwardsburg district.

One Cu-bearing skarn lies about 6 mi east of the favorable tract for mixed-metal skarns (fig. 17a). That copper skarn lies within the favorable tract for Cu-Au mixed-metal veins. It is interpreted as a skarn analogue of Cu-Au mixed-metal veins associated with the syenite-diorite stock of Ramey Ridge.

About 7 km south of the PNF, copper-tungsten-silver mixed-metal skarn is present in the Indian Creek district at the Copper Mountain prospect, which is near the Big Chief (Ag-Au-Cu-Pb), Jerico (Au-Cu-Mo), and Vesper (Ag-Au-Cu-Mo) vein and disseminated mineral occurrences. This cluster of skarn and mixed-metal vein occurrences is hosted in biotite-muscovite granite-granodiorite of the Idaho Batholith (Karen Lund, unpub. data, 1997). These prospects and occurrences were first classified as copper skarn and porphyry Cu-Mo prospects and occurrences (dc1 in appendix B). However, no porphyry-centered stockwork of Cu-Mo veinlets and skarns has been identified. Furthermore, copper, molybdenum, base- and precious-metals also are present in some mixed-metal skarns and veins of the Idaho Batholith. Therefore, these prospects and occurrences have been alternatively classified as Cu-bearing mixed-metal skarn, and Au-Ag mixed-metal veins of the Idaho Batholith (dc2 in appendix B).

Zn-Pb- and (or) Fe-bearing mixed-metal skarns: Zinc-lead-bearing skarn is associated with gold-silver mixed-metal veins, quartz-huebnerite veins, and iron skarn near the Combination mine, in the Profile district. Zinc-lead-bearing skarn is associated with copper-bearing skarn at the Ryan Creek prospect in the Edwardsburg district, and with a gold-silver mixed-metal vein at the Galena Central prospect in the Profile district.

Au-bearing mixed-metal skarn and hornfels: Gold-bearing skarn and hornfels are associated with distal disseminated gold-silver deposits of the Garnet Creek, Doris K, Cinnamid, and West End ore bodies in the Stibnite mining area of the Yellow Pine district. Those ore bodies are localized at intersections of dilatant faults with metasedimentary rocks that contain calc-silicate skarn, calc-silicate hornfels, and (or) biotite hornfels.

W-bearing mixed-metal skarns: Scheelite-bearing tungsten skarn is present in the in the Profile district at the Profile Gap prospect and the Syringa occurrence; in the Yellow Pine district at the Garnet Creek distal disseminated gold-silver deposit; and at the Oberbillig occurrence, south of the PNF.

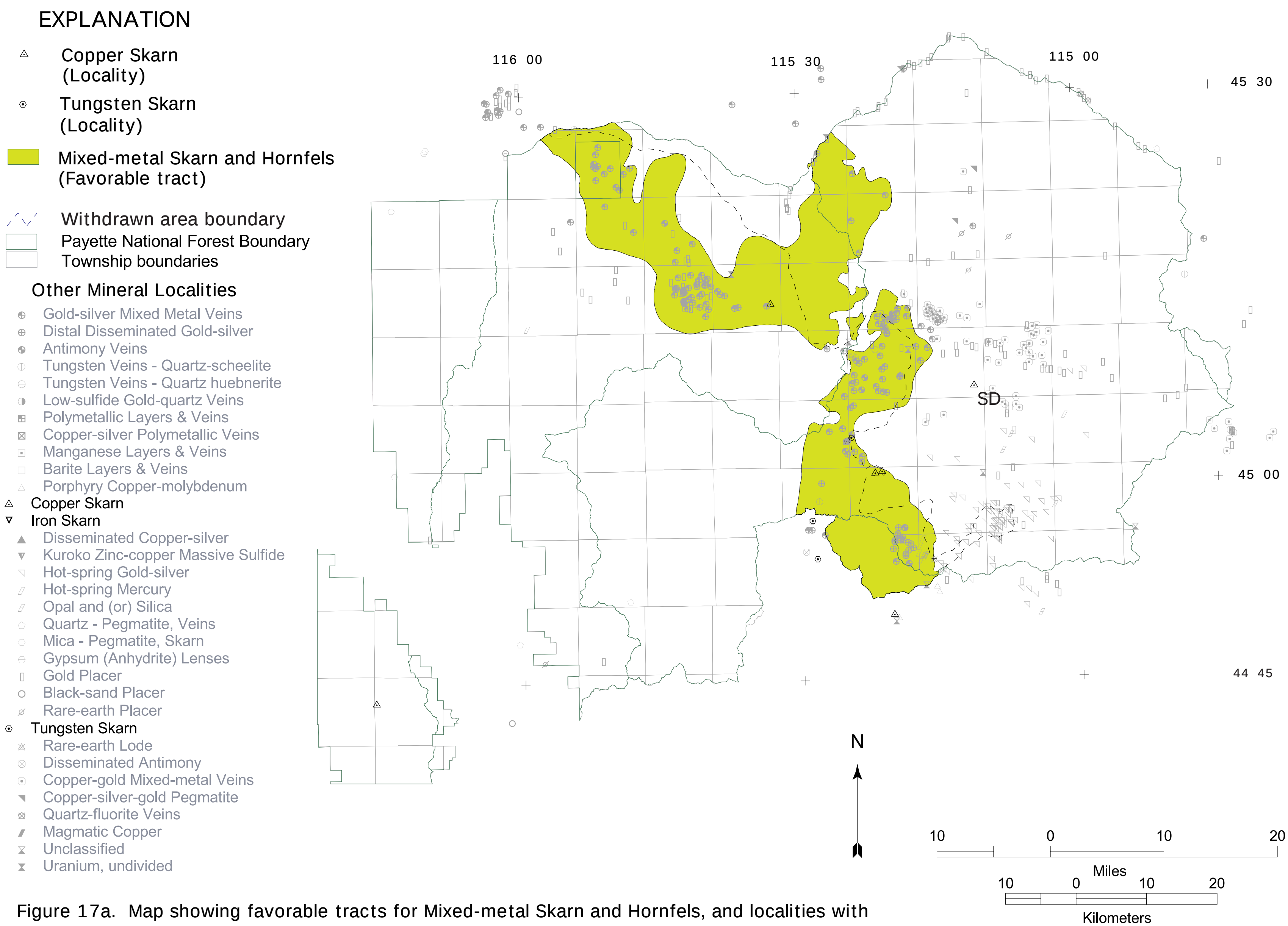


Figure 17a. Map showing favorable tracts for Mixed-metal Skarn and Hornfels, and localities with Mixed-metal Skarn and Hornfels (copper- or tungsten-bearing skarn or hornfels) as a second-rank component, eastern PNF. Most are associated with Au-Ag mixed-metal veins of the Idaho Batholith, but one (labeled SD) is associated with Cu-Ag mixed metal veins, related to syenite-diorite stocks.

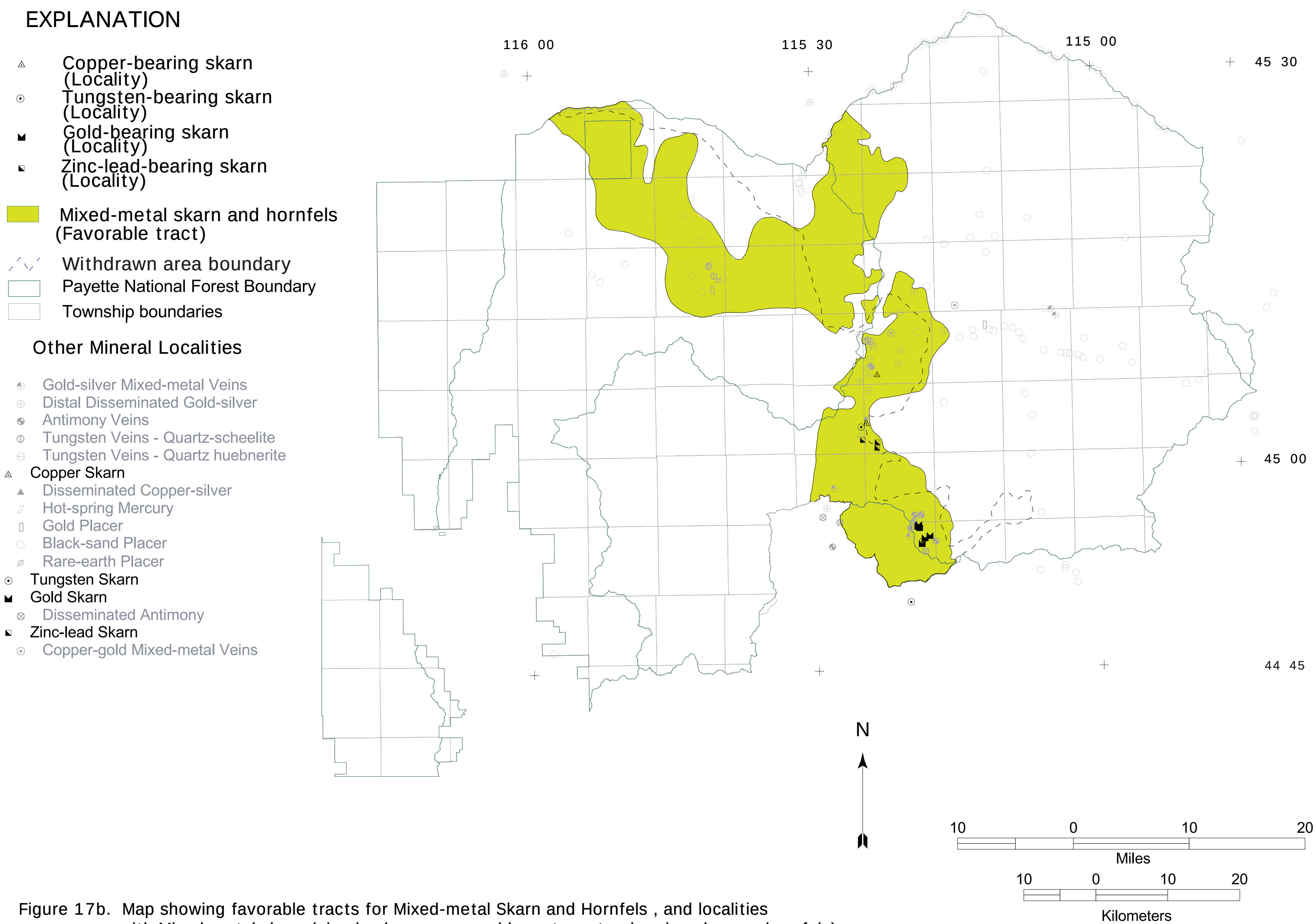


Figure 17b. Map showing favorable tracts for Mixed-metal Skarn and Hornfels , and localities with Mixed-metal skarn (zinc-lead-, copper-, gold-, or tungsten-bearing skarn or hornfels) as a third-rank component, eastern PNF.

Rationale for Tract Delineation

The Idaho Batholith (fig. 5) and a 10-km buffer zone around it are considered permissive for gold-silver mixed-metal veins. Favorable tracts for mixed-metal skarn and hornfels (figs. 17a and 17b) coincide with those for Au-Ag mixed-metal veins. Mixed-metal skarn and hornfels of the eastern PNF are regarded as analogues of Au-Ag mixed-metal veins, distal disseminated Au-Ag deposits, and (or) tungsten veins of the Idaho Batholith. The mixed-metal skarn and hornfels deposits are in metasedimentary rocks that host the Idaho Batholith, and in roof pendants and inclusions of those host rocks within in the eastern and northern parts of the Atlanta Lobe of the batholith.

The USGS model for Cu skarn lists porphyry copper as an associated deposit type. However, mixed-metal skarn and hornfels of the eastern PNF appear to be genetically associated with S-type two-mica granite of the Idaho Batholith, whereas porphyry copper deposits generally are centered on stocks of I-type porphyry of intermediate to felsic composition. Therefore the favorable tract for mixed-metal skarn and hornfels deposits of the eastern PNF is not considered favorable for the presence of porphyry copper deposits.

Reason for no Numerical Estimation

Mixed-metal skarns of the eastern part of the PNF are too small to fit the grade-tonnage models for Cu skarns, Zn-Pb skarns, Fe skarns, or W skarns. Gold-bearing calc-silicate hornfels is closely associated with distal disseminated gold-silver deposits, and is included in those numerical estimations of gold and silver resources. Therefore, no numerical estimates were made for numbers of undiscovered deposits and (or) undiscovered resources of Cu-, Zn-Pb-, Fe-, Au-, or W-bearing mixed-metal skarn and hornfels of the eastern PNF.

Development Forecast and Environmental Implications

Mixed-metal skarn and hornfels of the eastern PNF is unlikely to become a general target of mineral exploration or development activities in the foreseeable future. Therefore, environmental effects of localities with mixed-metal skarn and hornfels probably will be limited to those of existing small mines and prospects.

Gold-bearing skarn and hornfels may be of future exploration interest, but are likely to be explored and developed as parts of larger distal disseminated gold-silver deposits. For a development forecast and its environmental implications, see the previous section on distal disseminated gold-silver deposits.

Distal Disseminated Gold-silver
Deposit Code 002

USGS models -- Distal disseminated Ag-Au

USGS descriptive model 19c for Distal disseminated Ag-Au deposits, by Cox (1992), is accompanied by a grade-tonnage model by Cox and Singer (1992). These models were based on a small number of deposits, and were dominated by deposits with higher Ag/Au ratios than typical for distal-disseminated Au-Ag deposits of the PNF. An expanded grade-tonnage model by T.G. Theodore (unpub. data, 1998) is more appropriate for estimation of potential resources of deposits of this type in PNF, because it includes grades and tonnages of many Nevada and Idaho deposits, which have lower Ag/Au ratios.

Description -- Au-bearing stockworks, disseminations along dilatant fault zones

Distal disseminated gold-silver deposits are large-tonnage, low-grade, bulk-mineable deposits that are mined for sparsely disseminated gold and silver. Distal disseminated gold-silver deposits are interpreted as igneous-related hydrothermal deposits that are distant from genetically associated intrusions. The distinction between gold-silver mixed-metal veins and distal disseminated gold-silver deposits is that the veins are mined individually, whereas in distal disseminated deposits, mineralized breccias, and (or) multiple veins, veinlets, and (or) disseminations are mined in bulk. Thus, individual veins are relatively high-grade, small-tonnage deposits, whereas distal disseminated deposits are relatively low-grade, large-tonnage deposits.

Distal disseminated gold-silver deposits of the eastern PNF are present in pervasively fractured and hydrothermally altered plutonic rocks of the Idaho Batholith, as well as in metasedimentary rocks, intruded by the batholith, and included in it as roof pendants and inclusions. Distal disseminated gold-silver deposits of the PNF commonly are localized along northeast-striking dilatant segments and splays of right-lateral shear zones that regionally strike north-northeast. Pull-apart fracturing along dilatant northeast fault jogs and splays provided networks of pathways for movement of mineralizing hydrothermal fluids. Multiple episodes of fracturing allowed multiple episodes of hydrothermal mineralization.

Mineral assemblages of the Yellow Pine distal disseminated gold-silver deposit (described by Cooper, 1951; and Cookro and others, 1988) can be assigned to the paragenetic stages observed in gold-silver mixed-metal veins by Gammons (1988). Gold of Stage I is associated with quartz, sericite, and disseminated grains of pyrite (about 3 wt percent) and arsenopyrite (about 1 wt percent), which commonly replace biotite. Silver and gold of Stage II are associated with quartz-stibnite veins, lenses, stringers, veinlets and disseminations, with sericite. Electrum of Stage III and or Stage IV is associated with sparse base-metal sulfides and silver-bearing sulfosalts. Scheelite of Stage III and (or) Stage V is present as disseminations in brecciated gold ore, as branching veinlets and stringers, as crystals in massive stibnite, and as crystals near the centers of lenticular calcite veins. However, most scheelite was mined during World War II, and only small remnants were found in the Yellow Pine pit in 1997. Cinnabar of Stage VI is present at the North Monday distal disseminated gold-silver occurrence in the Stibnite mining area.

Distal disseminated gold-silver deposits of the Yellow Pine pit formed mostly during the same Late Cretaceous time interval when gold-silver mixed-metal vein minerals of Stages I to IV were deposited, and two-mica granite of the Idaho Batholith was emplaced and crystallized. Gammons (1988) reported an Argon-Argon age spectrum of 78 to 71 Ma on a sample of muscovite associated with the Yellow Pine distal disseminated gold-silver orebody. He also dated sericite of stages I to IV of gold-silver mixed-metal veins as 79 to 69 Ma. Lewis and others (1987) dated two-mica granite of the Idaho Batholith 78 to 72 Ma.

Cookro and others (1988) reported K-Ar age determinations on replacement adularia collected from the gold ore zone of the Yellow Pine pit yielded an average age of 57 ± 1 Ma (as determined by Lewis, 1984). This indicates a post-batholith stage of hydrothermal alteration, probably in association with scheelite of stage V (57 to 53 Ma). A dike of quartz-latite porphyry cuts the stockwork of stibnite-veined, silicified and sericitized granite in the Yellow Pine pit. The dike is chloritized and argillized but is not veined, and it contains no visible ore minerals. The dike is similar to other intrusions that have been dated as Eocene in age (51 to 39 Ma) by Leonard and Marvin (1982). Late chalcedonic silica, and epithermal cinnabar and gold of stage VI (<53 Ma) were overprinted locally on earlier distal disseminated Au-Ag deposits.

Disseminated gold-silver deposits of the eastern PNF are weathered and oxidized various depths by interactions with air and vadose groundwater. Oxidation destroys gold-bearing sulfide minerals, and leads to deposition of limonite and gold. Free gold, amenable to extraction by heap leaching with cyanide solutions, occurs where gold-bearing sulfides have been oxidized. Depth of oxidation varies with degree of fracturing, topography, and depth to the water table, from 0 in some outcrops, to about 30 m in the Yellow Pine pit, and about 240 m in the West End pit (Bart Stryhas, personal communication, 1992).

Interpretation -- multi-stage stockwork and disseminated mineralization of stages I to IV, related to two-mica granite of the Idaho Batholith ± post-batholith mineralization of stages V and VI

Distal disseminated Au-Ag deposits are interpreted as relatively large, low-grade equivalents of Au-Ag mixed-metal veins of the Idaho Batholith. Both are interpreted as manifestations of hydrothermal systems related to late two-mica granite of the Idaho Batholith. Distal disseminated Au-Ag deposits formed in broad fracture zones, commonly along dilatant jogs and splays of strike-slip faults that were active during successive stages of hydrothermal mineralization related to inferred subjacent plutons of two-mica granite.

Two-mica granite is interpreted as S-type granite, generated by partial melting of materials that had a significant sedimentary component (Lewis and others, 1987). Mineral deposits associated with S-type granites tend to be enriched in gold, tungsten, antimony and (or) arsenic. Also, mineral deposits associated with batholithic intrusions tend to be widely distributed, and to have long paragenetic histories that indicate formation over long time intervals. By contrast, porphyry copper systems, which tend to be associated with porphyritic stocks of I-type tonalite- to monzogranite (generated by partial melting of predominantly igneous source materials) tend to form rapidly, within relatively small areas that are centered within and around cupolas of high-level porphyry stocks.

Stage V scheelite may be related to very late, unexposed, probably granitic plutons of the Idaho Batholith, and (or) to long-lived circulation of post-magmatic hydrothermal fluids, associated with slow cooling of the very large mass of the Idaho Batholith. Late chalcedonic silica, cinnabar and gold were deposited from hydrothermal fluids related to the Eocene Thunder Mountain Caldera.

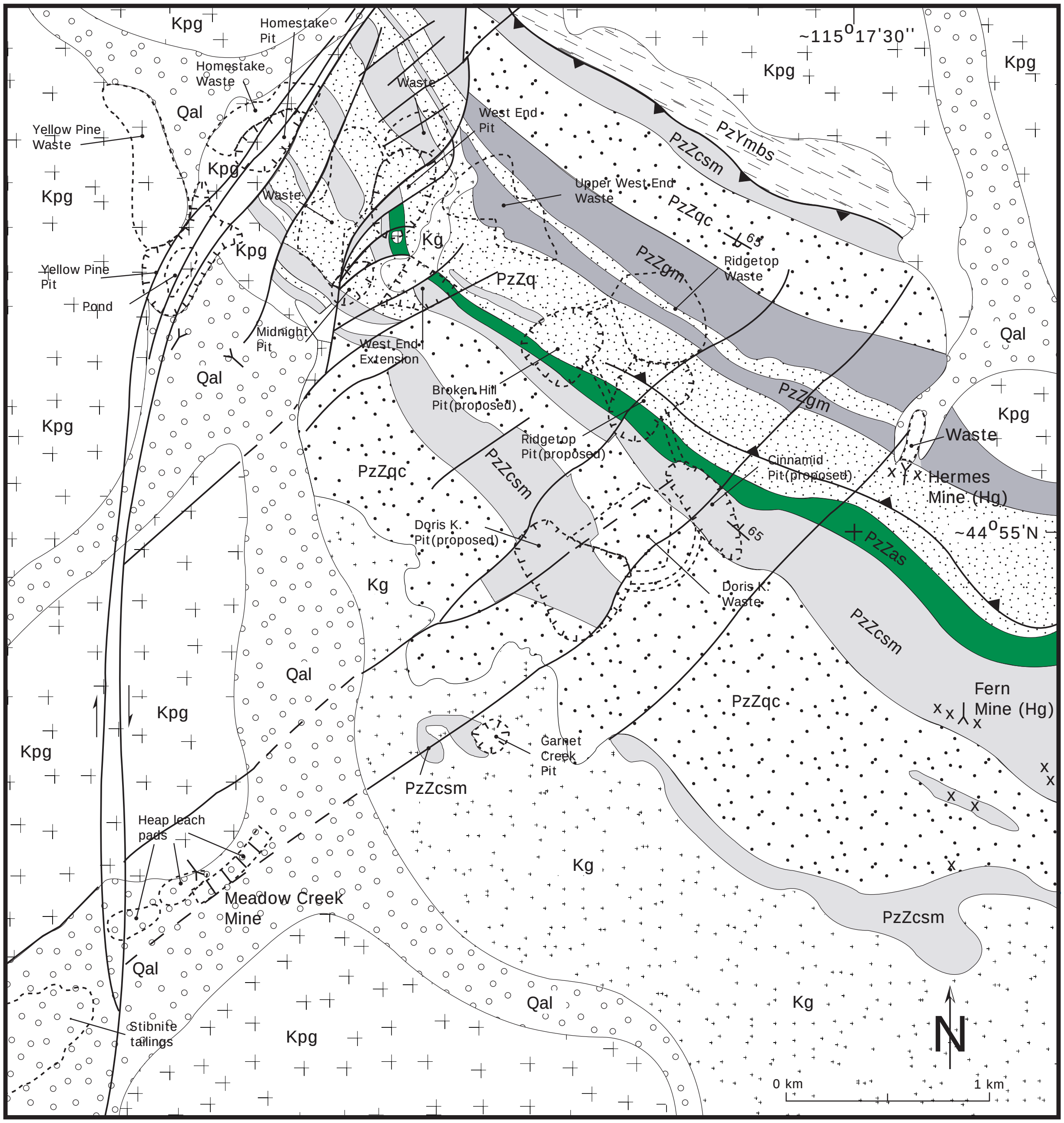


Figure18. Diagrammatic geologic map of the Stibnite mining area, Yellow Pine mining district (after USFS, 1994; Lund, 1997, in prep.; Smitherman, 1986).

Contact

Fault showing offset

Thrust fault (teeth on upper plate)

Open pit mine

Waste

Adit

x Small pit

EXPLANATION

Quaternary

Qal Alluvium

Cretaceous

Kpg Porphyritic granite

Kg Granite

Paleozoic? or Late Proterozoic?

PzZgm Gray Marble

PzZq Quartzite

PzZas Andulusite - mica schist

PzZcsm Quartzite, calc - silicate gneiss, marble

PzZqc Quartzite and quartz - pebble conglomerate

PzYmbs Muscovite - biotite schist

Table 9. Stibnite mining area: Production and resources of Distal Disseminated Gold-silver and other deposits

		Production (tonnes)				Resources (tonnes)		
Mine	**Deposit Type**	**Au**	**Ag**	**Sb**	**WO_3**	**Au (oxide)**	**Au (sulfide)**	**Comments**
Meadow Creek [1]	Gold-silver Mixed-metal Vein	1.54	5.23	3,180				6.3 ppm Au, 21.5 ppm Ag, 1.3 wt % Sb
Yellow Pine oxide [1]	Distal Disseminated Gold-silver, Disseminated Antimony, Quartz scheelite Veins	7.96	46.7	31,100	7,850			~3 ppm Au, 1.0 wt % Sb, 0.7 wt % WO_3
Yellow Pine sulfide [2]	distal disseminated gold-silver						48.9	sulfide @ 3.1 ppm Au
Homestake [2]	distal disseminated gold-silver	2.67	0.52					oxide @2.7 ppm Au
West End Midnight [2]	distal disseminated gold-silver	4.9						oxide @ 1.3 ppm Au
Stibnite Group [2] (Broken Hill, Ridgetop, Cinnamid, & Doris K)	distal disseminated gold-silver					2.6		oxide @ 1.8 ppm Au
Stibnite Group [2] (Broken Hill, Ridgetop, Cinnamid, & Doris K)	distal disseminated gold-silver					3.2		oxide @ 1.3 ppm Au
Stibnite Group [2] (Broken Hill, Ridgetop, Cinnamid, & Doris K)	distal disseminated gold-silver						9.5	sulfide @ 2.1 ppm Au
	Total	17.1	52.5	34,300	7,850	5.8	58.4	

1. Cookro and others (1988), Cooper (1951), and USBM (1996)
2. Randol (1992, 1994, 1996)

Examples

Table 2 and appendix B list 20 examples of distal disseminated Au-Ag occurrences as first-rank components, 16 as second-rank components, and 4 as third-rank components at mineral localities in and around the eastern PNF. The most significant of these are in the Stibnite mining area.

Stibnite mining area: The large and well-known distal-disseminated gold-silver deposits of the Stibnite subdistrict are in the east part of the Yellow Pine mining district, in a part of the Boise N.F. administered by the Krassel Ranger District of the PNF. The history of geological exploration, mining, and milling in the Stibnite mining area has been documented by Mitchell (1995). The geology of the Stibnite mining area is illustrated in figure 18, and metal production and resources of the area are summarized in Tables 3 and 9. The Meadow Creek mine at Stibnite was active in the 1930s. It was an underground mine on the Meadow Creek vein, a high-grade gold-silver mixed-metal vein, localized along a north-striking segment of the Meadow Creek fault, in granitic rocks of the Idaho Batholith. Antimony and other sulfides were concentrated by flotation. Gold and silver were recovered by roasting and cyanidation of iron-sulfide concentrates.

The Yellow Pine mine is about 4 km northeast of the Meadow Creek mine. It was begun in the 1930s as an underground mine on a set of northeast-striking fault-vein splays in granitic rocks on the northwest hanging wall of the Meadow Creek fault zone. Open-pit mining was begun in the late 1930s, and large reserves of surface bulk-mineable antimony-silver, tungsten, and gold ore were identified by drilling. In general, the deposit was elongated northeast and it narrowed downward. Distal disseminated gold was peripheral to stockwork and disseminated antimony and central quartz-scheelite veins (Cooper, 1951). Donald White, of USGS, identified scheelite in Yellow Pine drill core in 1941, and Yellow Pine became the largest tungsten producer in the United States during World War II. The tungsten was depleted in 1945, and production shifted to antimony and gold. The Yellow Pine mine and its mill and antimony smelter (at Stibnite) closed in the early 1950s (Mitchell, 1995). Ore from the Meadow Creek and Yellow Pine mines was processed by milling and flotation, and tailings were deposited in the valley of upper Meadow Creek.

In the late 1980s, oxidized ore from the Yellow Pine distal disseminated gold-silver deposit was mined from the Yellow Pine pit, and gold was recovered by cyanide heap leaching (Mitchell, 1995). A large distal disseminated gold resource remains beneath the lake that presently occupies the bottom of the Yellow Pine pit. However, the resource is low-grade, and the gold is contained in sulfide minerals, so it is not amenable to extraction by cyanide heap leaching without artificial oxidation. The low-grade sulfide gold resource is therefore subeconomic at present. Production and resources of the Yellow Pine orebody are summarized in table 9.

The Homestake distal disseminated gold-silver orebody, now the site of the depleted Homestake pit, was localized in broken, hydrothermally altered and mineralized granitic rocks in the northwest hanging wall of the Meadow Creek fault, about 0.3 to 0.7 km northeast of the Yellow Pine orebody. The Homestake orebody was discovered on the basis of antimony and gold geochemical anomalies found by the US Bureau of Mines in the 1930s. The orebody was open-pit mined in the late 1980s and early 1990s, and gold was recovered by cyanide heap leaching (Mitchell, 1995). Production of the Homestake mine is summarized in Table 9.

The West End distal disseminated gold orebody was largely depleted by the end of 1996, but the West End Extension was mined in 1997 (fig. 18). The West End pit is on the northeast-facing slope above West End Creek, about 0.4 to 0.7 km southeast of the Homestake pit. The West End orebody was localized at the intersection of northeast-striking splays of the West End fault and northwest-striking layers of Proterozoic metasedimentary mica schist and amphibole-garnet skarn and marble. Both the fault splays and the metasedimentary layers dip steeply. Bradley Mining Co. discovered the West End Creek prospects in 1943. Soil sampling by Leonard (1973) defined a target for further exploration. The deposit was mined from 1982 to 1993 (Mitchell, 1995). Oxidized ores extended to about 240 m deep along the West End fault (Bart Stryhas, personal communication, 1992). In table 9, production of the West End pit is combined with that of the semi-contiguous Midnight, Splay, and Northeast pits, all of which lie along the West End fault system. Ore from these pits was crushed and cyanide heap-leached. Leach pads were in the lower Meadow Creek valley. After removal of gold and silver, the crushed spent ore was rinsed and placed on pulverized mill tailings in upper Meadow Creek.

Six additional oxidized distal disseminated orebodies have been identified by geologic mapping (Smitherman, 1988), geochemical sampling, and drilling in the Stibnite area. The proposed Stibnite, Broken Hill, Ridge Top, Cinnamid, and Doris K pits are localized at intersections of northeast-striking faults with northwest-striking metasedimentary rocks, especially those that contain carbonate and (or) calc-silicate minerals (fig. 18). The Garnet Creek orebody is localized along the northeast-striking Garnet Creek fault, where it intersects Cretaceous granitic rocks with inclusions of garnet-bearing calc-silicate rocks.

Moscow mine: The Moscow mine, which was mined for gold-silver mixed-metal veins, has been explored recently for distal disseminated gold-silver. The Moscow mine area is in the Edwardsburg district, in the northeast quarter of the Profile Gap 7.5' quadrangle. The Moscow mine produced a small amount of gold (<0.1 tonne) between 1907 and 1912, from many small workings, along a swarm of northeast-striking, southeast-dipping quartz veins as much as 0.7 m thick (USBM, 1996). The vein zone is localized in and around the contact between Cretaceous biotite-muscovite granite and a large inclusion or roof-pendant of Proterozoic metasedimentary rocks. Host rocks are silicified, sericitized, and limonite stained around and between the veins, suggesting a large volume of oxidized, distal disseminated gold-silver mineralized rock. The USBM collected 65 samples from throughout the prospect area in 1990-91, most of which contained detectable gold. Between 1989 and 1992, Kennecott Exploration Co. discovered a drill-indicated resource of about 6.7 tonnes of gold, in 3.8 million tonnes of ore, with an average grade of 1.75 ppm gold (Stuart Moller, consulting geologist, oral commun., 1993). A geologic map of the area, showing drill roads and sample sites, is included in a USBM report by Beuhler and others (1993).

Red Mountain prospect: The Red Mountain distal disseminated gold prospect is in the Profile mining district, in the southwest quarter of the Profile Gap 7.5' quadrangle, on a limonite-stained spur (Red Mountain) that extends north-northwest from Quartz Ridge. In 1992 the exploration workings consisted of 4 mi of roads, 4 adits (3 caved), 17 prospect pits, and 41 drill holes (Beuhler and others, 1993).

Rocks of the Red Mountain spur are hydrothermally altered granite of the Idaho Batholith. The zone of altered granite is roughly elliptical in plan, with its long axis extending about 1 km along the north-northwest-trending ridge, and its short axis extending about 0.6 km across the ridge (Buehler and others, 1993). Broad zones of altered granite also extend south and east from the ridge. Two areas of massive milky quartz are present along the ridge top, and one trends southward from the ridge top. The silicified zones are surrounded by anastamosing swarms of quartz veins and veinlets, most of which strike north-northwest, and some of which contain minor pyrite, and rare scheelite and (or) molybdenite. Granite between the veins and veinlets is sericitized, and joint surfaces in weathered rocks of this zone are coated with goethitic limonite. Around the quartz-sericite zone is a zone of bleached and argillized granite, which grades outward to a broad halo of greenish gray chloritized granite.

Several radial dikes and one concentric dike are centered on the northern high-silica zone, and several radial dikes are centered on the southern high-silica zone. The dikes are felsic latite, quartz-latite, and rhyolite porphyries. The dikes cut veined and silicified granite but are only jointed and argillized. Leonard (1980) regarded the Red Mountain area as a prospect for deep disseminated molybdenum-tungsten deposits, as indicated by the presence of molybdenite and scheelite in vein swarms cut by radial and concentric felsic dikes, suggesting a subjacent stock of felsic porphyry. However, the Red Mountain prospect appears to be sulfide-poor in comparison to quartz-sericite zones around major porphyry molybdenum deposits.

Leonard and Erdman (1983) outlined soil and (or) biogeochemical anomaly patterns for gold, silver, arsenic, antimony, mercury, molybdenum, tungsten, and tin at Red Mountain. The anomaly pattern for molybdenum covers an elliptical area (0.9 x 0.6 km across) that extends across the quartz-sericite and argillic zones of alteration around both high-silica foci. A smaller biogeochemical anomaly pattern for gold covers an elliptical area that extends 0 to 0.6 km southeast of the south focus of high-silica rock, and is about 0.4 km across (B.F. Leonard, personal communication, 1993). Buehler and others (1993) presented assays from 47 samples taken at Red Mountain by USBM. The maximum gold concentration was 3.4 ppm; 17 contained > 0.47 ppm gold; and most samples contained detectable gold. Placer Dome Exploration Co. drilled the Red Mountain prospect in 1988, and identified a low-grade gold resource of about 7.7 tonnes of gold in 9 million tonnes of mineralized rock, with an average grade of 0.9 ppm gold (Bart Stryhas, personal communication, 1992).

Red Bluff - Morning Star prospect area: The Red Bluff tungsten mine and the Morning Star tungsten claims lie in a quartz-veined and iron-stained area that has been drilled for distal disseminated gold-silver. The prospect area is near the west margin of the central Edwardsburg district, in the southwest quarter of the Wolf Fang Peak 7.5' quadrangle. It lies west of the South Fork of Smith Creek, on the upper east- and southeast-facing slopes of the ridge between the South Fork and tributaries of the Middle Fork of Smith Creek. It lies northwest of the Independence mine area and southeast of the McRae mine area.

The Red Bluff - Morning Star prospect area is elongate north-northeast, and is about 1.2 km long and 0.6 km across. Cretaceous porphyritic muscovite-biotite granite is silicified, sericitized, cut by quartz veins and veinlets, and iron-stained. Most of the quartz veins and veinlets strike north-northeast, parallel to the long axis of the prospect area. Tertiary granite porphyry dikes cut the mineralized and altered Cretaceous granite. The dikes strike north-northeast, parallel to the veins, but the dikes are not noticeably mineralized, and are only weakly altered.

The Red Bluff - Morning Star prospect area was explored on a DMEA (Defense Minerals Exploration Administration) contract in the 1950s, and by Freeport McMoran, Independence, and Great Basin exploration companies in the late 1980s and early 1990s. In about 28 drill holes, several intercepts contained about 1 ppm gold. Two much higher-grade intercepts (about 6 ppm gold) were widely separated and unconnected (Stuart Moller, geological consultant, personal communication, 1992). Exploration drill roads in the area were reclaimed in about 1994.

Antimony - Rainbow prospect area: The Antimony Rainbow prospect area is about 6 km west of Edwardsburg and extends across the ridge between Government Creek and the north fork of Logan Creek. Buehler and others (1993) mapped and sampled the area, which was leased to NERCO, and had been explored recently for disseminated gold-silver deposits by Freeport McMoran Gold Co. (renamed Independence Mining Co.) and Great Basin Exploration and Mining Co. Granitic rocks of the Idaho Batholith, with metasedimentary inclusions, are cut by many quartz-rich gold-silver mixed-metal veins with silicified wall rocks. The veins strike north-northeast and dip steeply. Eocene porphyry dikes also strike north-northeast and dip steeply, but are not silicified and are only weakly argillized. Buehler and others (1993) collected, described and analyzed 212 samples, of which 52 contained > 0.3 ppm gold, 11 contained > 3 ppm gold, and one contained 7.8 ppm gold across a 1 m - wide shear zone. Many samples also contained notable concentrations of silver, arsenic, antimony, tungsten, lead, zinc, copper, and mercury. At the upper adit of the Ludwig Mine (more accurately named the upper McRae adit), a resource of approximately 0.5 tonnes of gold was delineated in 270,000 tonnes of rock averaging 1.9 ppm gold (Buehler and others, 1993, p. 20).

Rationale for Tract Delineation

The permissive tract for disseminated gold-silver deposits includes the Idaho Batholith (fig. 5) and a 10 km buffer zone around it. The favorable tract for distal disseminated gold-silver deposits (figs. 19a,b,c) coincides with the southeastern tract for gold-silver mixed-metal veins, and with the tracts for antimony veins, and disseminated antimony deposits. This tract includes a broad zone of faults, shear zones and veins that spans the eastern margin of the Idaho Batholith and its host rocks. It includes the Yellow Pine, Profile, and Edwardsburg mining districts, and the west part of the Big Creek district. The favorable tract is the assessment tract.

Deposit types associated with distal disseminated Au-Ag deposits in the eastern PNF include Au-Ag mixed-metal veins, mixed-metal hornfels and skarn, antimony veins, disseminated antimony, and tungsten veins. Unlike some distal disseminated Ag-Au deposits, which are associated with porphyry copper deposits (Cox, 1992), those of the eastern PNF probably are not associated with porphyry copper deposits. They are related to a batholithic pluton of two-mica granite, which is unlike the stocks of quartz diorite to monzogranite porphyry associated with most porphyry copper deposits. The geology of the favorable tract for distal disseminated Ag-Au deposits is not considered favorable for porphyry copper deposits, because evidence for their existence is lacking within the eastern PNF.

Rationale for Numerical Estimation

New grade-tonnage models for distal disseminated gold-silver deposits have been developed recently by Greg Spanski, using tonnage and grade data for known deposits in Idaho and Nevada (Theodore, unpub. data). The following central Idaho deposits are included in the new model: Yellow Pine, West End, Homestake, Moscow, Red Mountain, Elk City, Beartrack, and Humbug. Inclusion of these deposits in the new model makes it better suited than the previous model by Cox and Singer (1992) for use in estimating the tonnage and grade of similar undiscovered distal disseminated gold deposits in central Idaho.

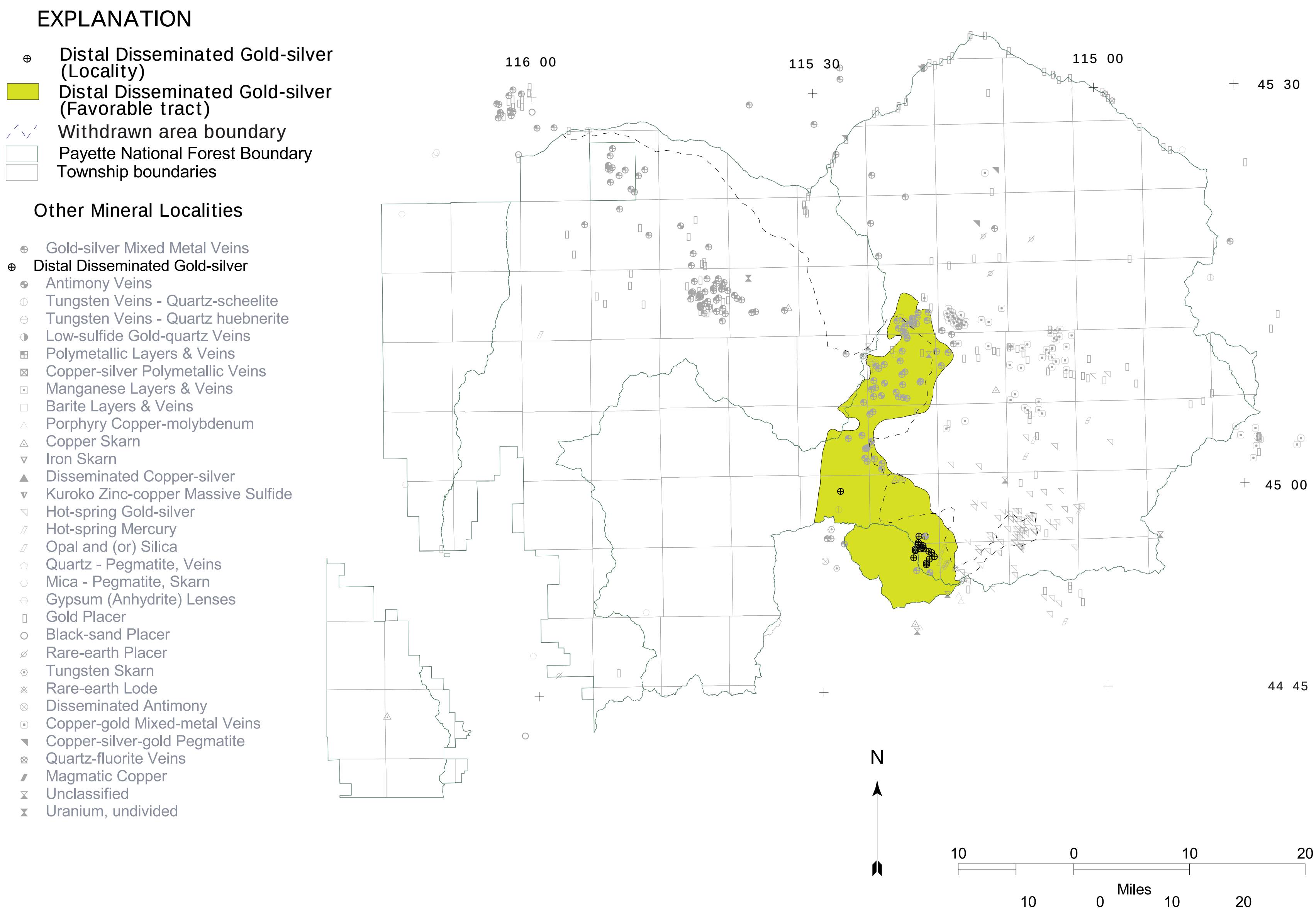


Figure 19a. Map showing favorable tract for Distal Disseminated Gold-silver deposits, and localities with Distal Disseminated Gold-silver as a first-rank component, eastern PNF.

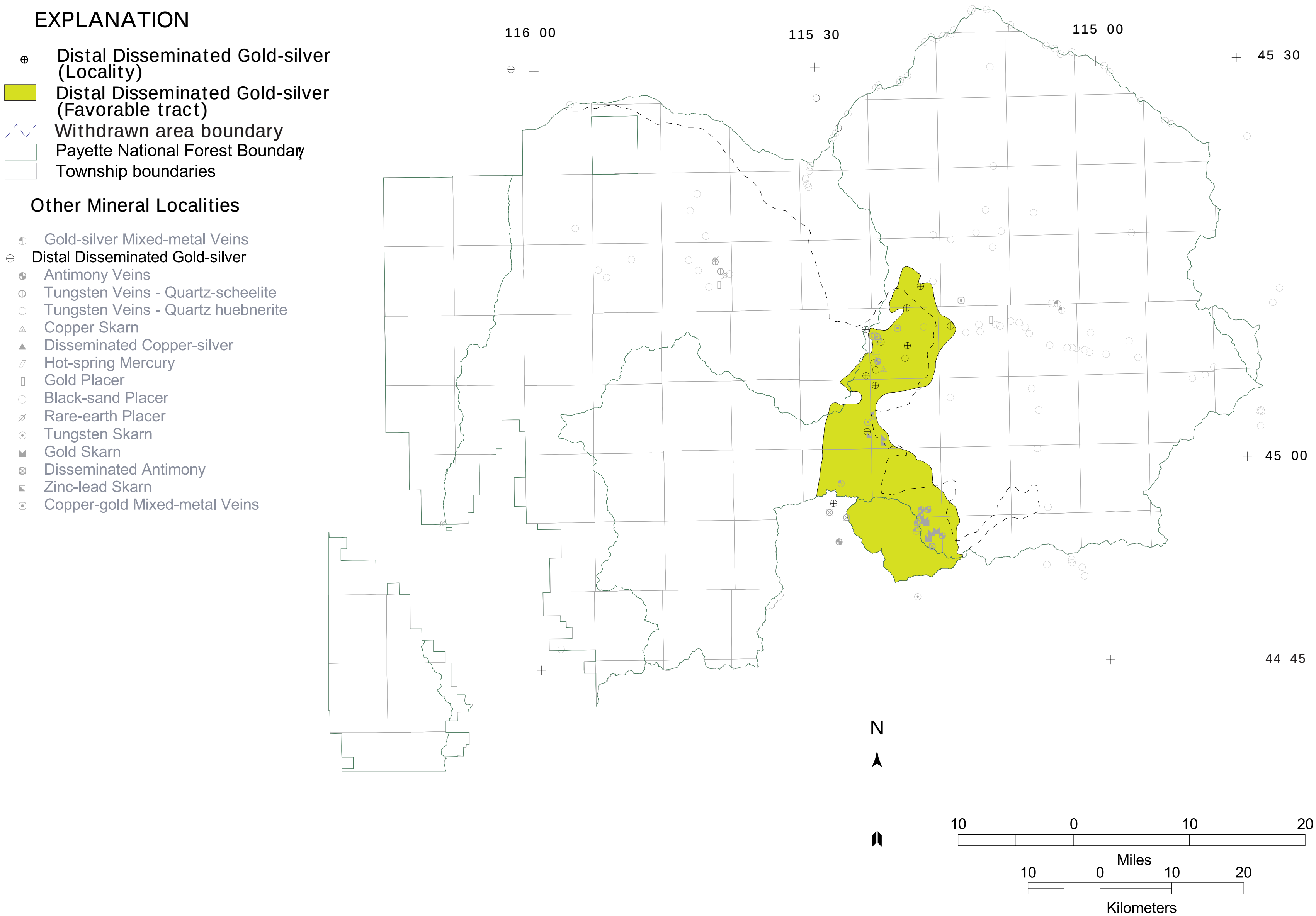


Figure 19b. Map showing favorable tract for Distal Disseminated Gold-silver deposits, and localities with Distal Disseminated Gold-silver as a second-rank component, eastern PNF.

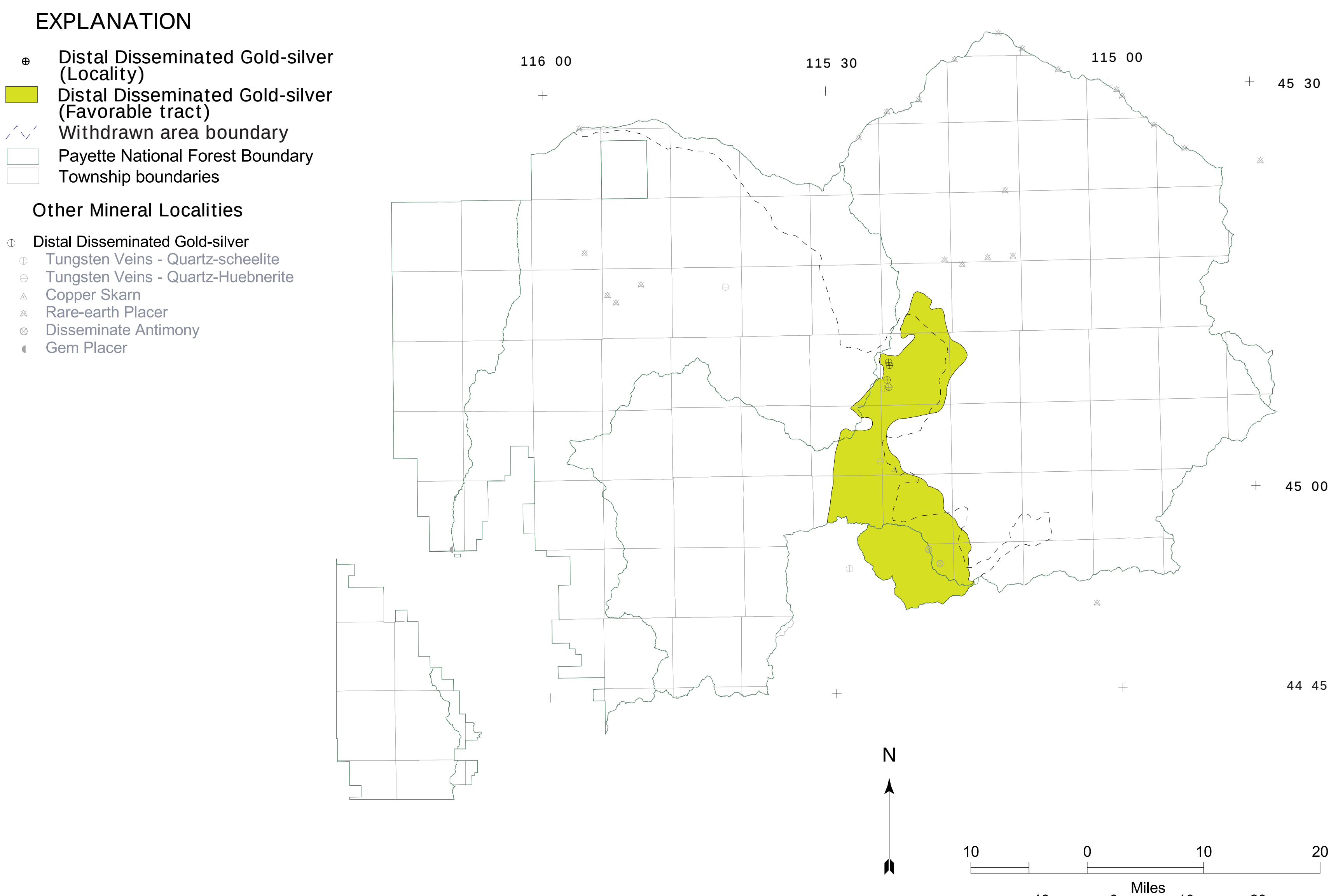


Figure 19c. Map showing favorable tract for Distal Disseminated Gold-silver deposits, and localities with Distal Disseminated Gold-silver as a third-rank component, eastern PNF.

Table 10. Distal Disseminated Gold-silver: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Distal Disseminated Gold-silver (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	1	3	5	7

Mark 3 output

Estimate of probability of 0 deposits: 31%

Estimate of probability of the median number of deposits (1): 31%

Estimate of mean expected number of deposits: 1.5

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Distal Disseminated Gold-silver (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
gold	0	5.8	71	24	20%
silver	0	0	540	310	20%
ore	0	5,000,000	47,000,000	16,000,000	20%

Estimation of numbers of undiscovered deposits was done by counting targets and considering the favorability of their attributes, such as widespread limonite, northeast-trending fault jogs or splays, granitic rocks of the Idaho Batholith in fault contact with carbonate- or calc-silicate-bearing metasedimentary rocks, pervasively altered rocks, clusters of veins and (or) disseminated ore minerals, and (or) geochemical anomalies for gold and (or) arsenic. Subjective estimates were made of targets likely to fit between the 10th and 90th percentiles of the tonnage and grade models for distal disseminated gold-silver deposits. Estimates made at the 1994 team meeting included 5 unannounced discoveries in the Stibnite mining area, which have since been announced. In 1997, those deposits (or extensions) were added to the identified resources (table 9), and subtracted from estimations of numbers of undiscovered deposits (table 10). For the 90th, 50th, 10th, 5th, and 1st-percentile levels of subjective probability, 0, 1, 3, 5, and 7 undiscovered deposits were estimated. In 1994, the tonnage and grade model of Cox and Singer (1992) was used to estimate the gold and silver resources of the undiscovered deposits. In 1997, new and improved tonnage and grade models, described above, were used to re-estimate the gold and silver resources of undiscovered distal disseminated Au-Ag deposits of the PNF. Table 10 summarizes results of the estimation of gold and silver resources of undiscovered distal disseminated Au-Ag deposits.

Development Forecast

Stibnite Mine expansion project: In 1992, Stibnite Mines, Inc. (SMI), submitted a proposal to PNF to expand their existing operations by developing five new open pits (the Stibnite, Broken Hill, Ridgetop, Cinnamid, and Doris K pits), associated haul roads, and two new waste dumps (one in the upper West End Creek drainage, and one in the upper Midnight Creek drainage). The proposed mine expansion would result in the disturbance of about 265 acres to mine 15 million tons of ore and 37.5 million tons of waste and extend the mine life by about 15 years, operating 6 months per year. In 1994 PNF released a Draft Environmental Impact Statement (DEIS), (USDA Forest Service, 1994), which was then withdrawn in 1995, because of concerns raised during the comment period.

In February, 1996, PNF received a modified proposal to develop four mine pits (not five), and to partially backfill the pits, so that no exterior waste dumps would be required. The modified project would disturb about 142 acres to mine about 7.9 million tons of ore and 19.5 million tons of waste over an 8 to 10 year project life, operating 6 months per year (PNF Newsletter, May 9, 1996). This production would come from the following pits, listed in the sequence to be mined: Broken Hill, Ridgetop, Cinnamid, and Doris K. A new DEIS, based on this modified proposal, is in preparation (Laurie Kelso, USFS, oral commun., 1997).

In the summer of 1997, mining proceeded on the West End Extension, at the southeast end of the West End pit. The Garnet Creek pit, which was permitted in 1981, was depleted and will be reclaimed (Laurie Kelso, USFS, oral commun., 1997).

Pending gold prices of about $350/troy oz ($11.25/g) or more, exploration and mining are likely to continue in the Stibnite mining area over the next ten years. Exploration efforts are likely to focus on extensions of known resources, and on a continuing search for additional deposits, possibly in covered areas, along northeast-trending fault jogs and splays, intersections of faults, and intersections of faults with metasedimentary rocks that contain carbonate and (or) calc-silicate minerals. However, if gold prices remain below about $350/troy oz for long, mining the known deposits may become uneconomic. In such circumstances, which are not unlikely, mines of the Stibnite area would become inactive, as would exploration for other distal disseminated gold-silver deposits in PNF.

Over the next ten years, it may feasible to recover gold from the large, low-grade pyrite-arsenopyrite-gold deposits, possibly by autoclaving or bio-oxidation of sulfides, to make refractory sulfide ores amenable to heap leaching. Large sulfide resources underlie the oxide ores that have recently been mined. Mining of the sulfide resources would greatly expand the scope and extend the duration of mining development in the Stibnite mining area.

Moscow mine and other prospects: Gold grades of the Moscow mine area, the Red Mountain Prospect, and the Red Bluff - Morning Star areas are subeconomic, considering their remote locations and snowy winter conditions. A strong and sustained rise in the price of gold probably would be required to renew exploration and development activities at these mines and prospects, or others like them.

Environmental Effects and Implications

Environmental implications of four development alternatives for the proposed Stibnite Mine Expansion Project were thoroughly presented in the 1994 Draft Environmental Impact Statement (USDA Forest Service, 1994). The main environmental concerns were 1. surface disturbance, 2. potential instability of side-hill pits and waste-rock dumps, 3. increased potential for spills of fuel and other toxic liquids being hauled to the mine site along narrow mountain roads near streams, 4. increased downstream sedimentation, 5) acid mine drainage, and 6) high arsenic in water.

The 1996 revised proposal, DEIS, and final EIS will reduce the disturbed area to 142 acres. Partial backfilling of smaller pits will increase stability of pits and waste-rock dumps. Recommended best-management practices will minimize erosion and downstream sedimentation. If mining and stripping are confined to thoroughly oxidized ores, relatively minor amounts of acid-generating pyrite or arsenopyrite will be exposed, and mine-drainage waters should not become strongly acidic. However, sediments and waters derived from the Stibnite mining area will continue to have moderately high contents of arsenic and antimony, which are relatively soluble at neutral pH.

Primary ores of the Stibnite mining area contain arsenopyrite (FeAsS) and stibnite (SbS_3). In oxidized ores, arsenic and antimony tend to be concentrated in iron and manganese oxides, by adsorption (Gualtieri, 1973; Miller, 1973). Bookstrom and Mosier (in prep.) collected six water samples from the Stibnite mine area in August of 1993. Sample pH ranged from 6.9 to 8.5. A 0.2-micron-filtered and acidified water sample from a monitoring well in pulverized tailings from the old Stibnite mill contained 7,500 ppb arsenic and 1,400 ppb antimony. Relatively dilute surface water samples contained 49 to 130 ppb arsenic, and 20 to 70 ppb antimony. The U.S. Environmental Protection Agency National Aquatic Life maximum concentration standard is 360 ppb for arsenic, and the National Primary Drinking Water maximum concentration standard is 50 ppb for arsenic, and 6 ppb for antimony (Da Rosa and Lyon, 1997, p. 83). Results from seasonal sampling of surface waters are given in the 1994 draft EIS (USDA Forest Service, 1994). Inspection of the data indicate that arsenic concentrations tend to be less than Idaho in-stream standards (1,900 ppb) at most of the sample stations, most of the time, but arsenic concentrations reach 2,200 to 2,600 ppb at some stations, during the winter low-flow season, when dilution is minimal.

Antimony Veins
Deposit Type Code 003

USGS Model -- Simple Sb deposits

USGS descriptive model 27d for Simple Sb deposits includes quartz-stibnite veins, pods, and disseminations (Bliss and Orris, 1986a). A first accompanying grade-tonnage model is for vein-dominated deposits (Bliss and Orris, 1986b). A USGS general descriptive geoenvironmental model for stibnite quartz deposits, applicable to antimony veins, was written by Seal, Bliss and Campbell (1995).

Description -- quartz-stibnite veins

Antimony veins (or Simple antimony deposits) are quartz veins that contain stibnite in massive pods, lensoidal streaks, and (or) bladed aggregates in open-space pockets (Bliss and Orris, 1986a). Silica-sericite-clay alteration envelopes surround simple antimony veins, and commonly contain disseminated stibnite pods and grains, along with sparsely disseminated pyrite.

Interpretation -- stage II mineralization, related to two-mica granite of the Idaho Batholith

Antimony veins of the eastern PNF are interpreted as quartz-antimony veins of stage II of the paragenetic sequence of veining related to Late Cretaceous two-mica granite of the Idaho Batholith.

Examples

Table 2 and appendix B list 7 first-rank and 5 second-rank examples of antimony veins in the PNF and vicinity.

Antimony Ridge mine: The Antimony Ridge mine is in the Yellow Pine mining district, just outside the PNF. According to Schrader and Ross (1926), the deposit mined was a single northeast-striking, steeply-dipping quartz-stibnite vein, offset by several northwest-striking faults. The thickness of the vein generally ranged from 15 to 45 cm, but locally swelled to 1.5 m. About 50 tonnes of antimony were produced from 100 tonnes of mined ore with an average grade of 50 percent antimony, with minor silver and trace gold (Schrader and Ross, 1926, p. 148). Some stibnite also is present in smaller veins, veinlets, and replacement pods, hosted in silica-sericite-clay altered granodiorite that surrounds the vein.

Meadow Creek mine: The Meadow Creek mine, in the Stibnite subdistrict, produced 3,180 tonnes of antimony from a gold-silver mixed-metal vein with a strong antimony-vein component (table 9).

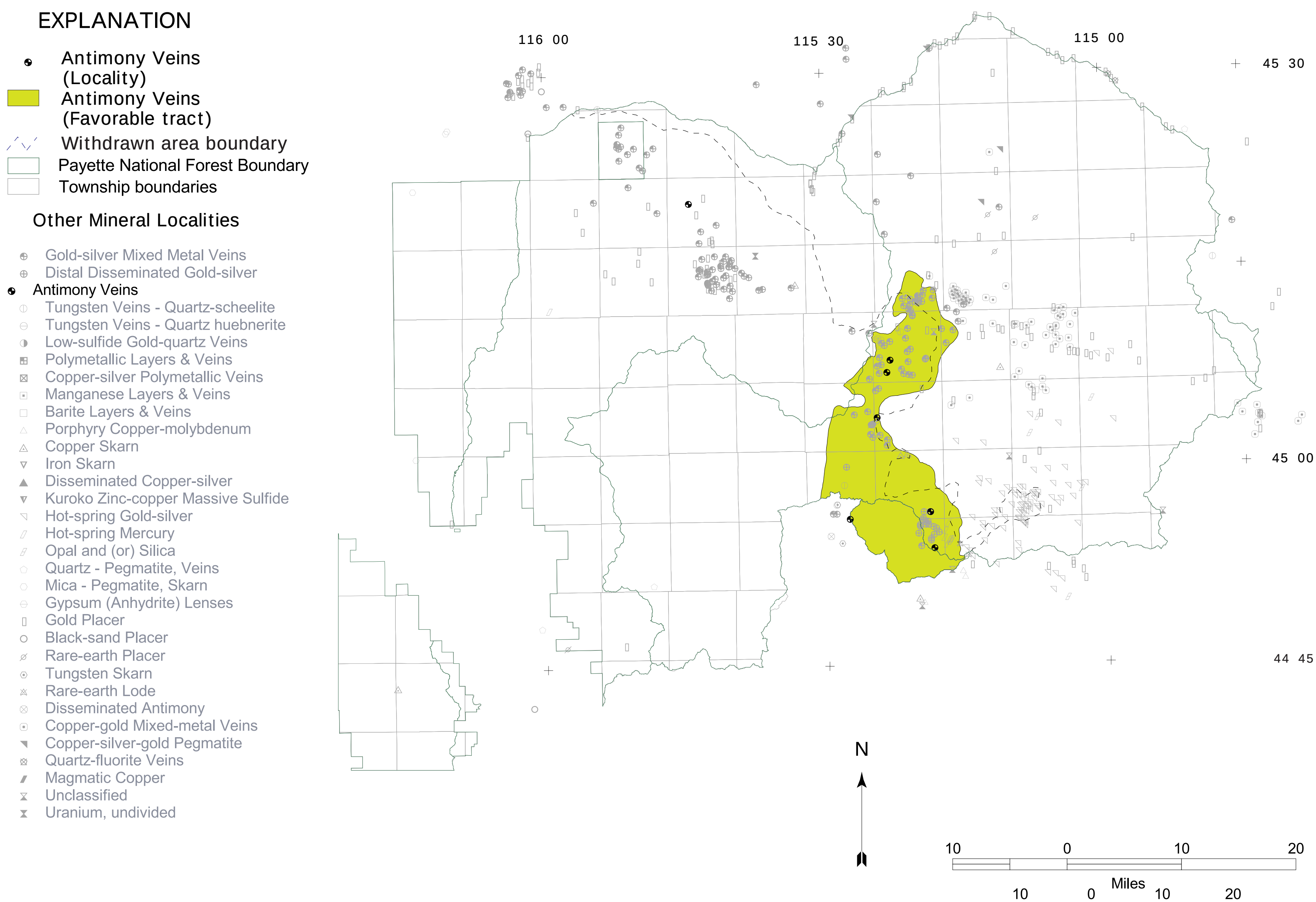


Figure 20a. Map showing favorable tract for Antimony Veins, and localities with Antimony Veins as first-rank components, eastern PNF.

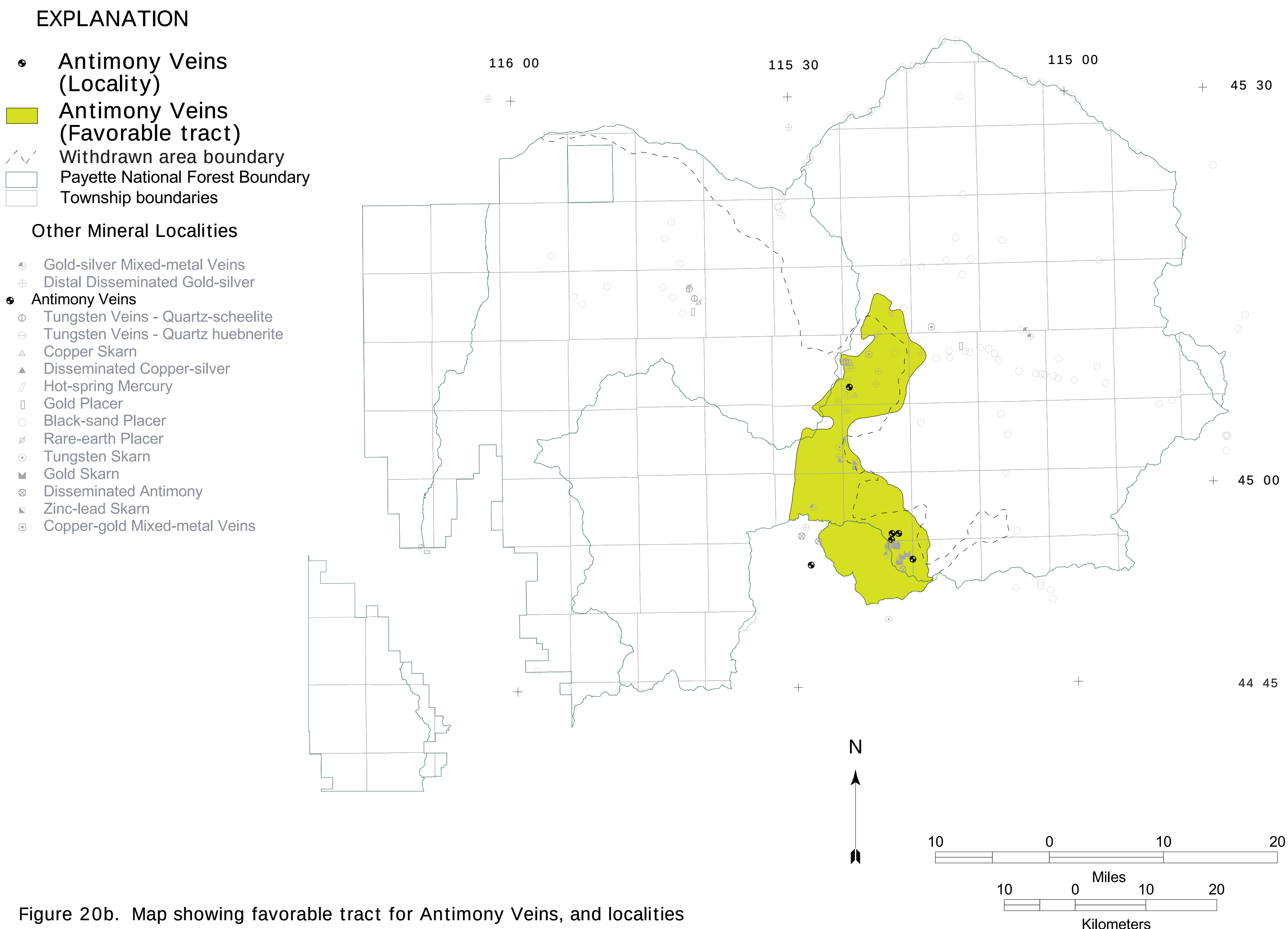


Figure 20b. Map showing favorable tract for Antimony Veins, and localities with Antimony Veins as second-rank components, eastern PNF.

Table 11. Antimony Veins: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Antimony Veins (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	1	4	8	13

Mark 3 output

Estimate of probability of 0 deposits: 29%
Estimate of probability of the median number of deposits (1): 27%
Estimate of mean expected number of deposits: 2.1
Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Antimony Veins (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
antimony	0	78	4,500	2,200	16%
ore	0	220	15,000	7,900	12%

Rationale for Tract Delineation

The permissive tract for antimony veins includes the Idaho Batholith (fig. 4) and a 10 km buffer zone around it. Antimony veins of the PNF are equivalent to the antimony component of mixed base- and precious-metal veins of the Idaho Batholith. Quartz and stibnite are constituents of Stage II and Stage VI mineral assemblages described by Gammons (1988).

The favorable tract for antimony veins (figs. 20a, 20b) coincides with the southeastern tract for gold-silver mixed-metal veins, and the tracts for distal disseminated Au-Ag deposits, antimony veins, and disseminated antimony deposits. This tract includes a broad zone of faults, shear zones and veins that spans the eastern margin of the Idaho Batholith and its host rocks. It includes the Yellow Pine, Profile, and Edwardsburg mining districts, and the west part of the Big Creek district. The favorable tract is the assessment tract.

Rationale for Numerical Estimation

The Antimony Ridge mine produced about 50 tonnes of antimony from 100 tonnes of ore. That ore tonnage is somewhat less than the median, but the grade is in the upper quartile for simple antimony veins of the tonnage-grade model by Bliss and Orris (1986b, model 27d). Use of the model is therefore justified to estimate the size and grade of undiscovered simple antimony veins in the PNF

Numerical estimation of undiscovered deposits was done by target counting and evaluation, and was based on the distribution of known antimony vein localities, areas of favorable geology, and consideration of exploration history versus extent of surficial cover. Subjective estimates were made of how many targets are likely to fit between the 10th and 90th percentiles of the tonnage and grade models for simple antimony veins. For the 90th, 50th 10th, 5th and 1st percentiles of subjective probability, the team estimated 0, 1, 4, 8, and 13 undiscovered deposits that would range in size and grade between the 90th and 10th percentiles of the tonnage-grade model by Bliss and Orris (1986b). Results of the estimation of undiscovered resources in antimony veins are summarized in table 11.

Development Forecast

It is unlikely that antimony veins in the eastern PNF will be developed in the foreseeable future, because such deposits probably would be relatively high-cost producers. Nevertheless, antimony vein prospects may continue to be explored, because some of them may be associated with distal disseminated gold-silver deposits.

Environmental Effects and Implications

Acid-generating capacity of quartz-stibnite deposits is low, but drainage water from mines, waste rocks, and tailings may contain elevated abundances of antimony, arsenic, and sulfate (Seal, Bliss, and Campbell, 1995). Mines and prospects on antimony veins in the eastern PNF are small and probably have only local and minor environmental effects.

Disseminated Antimony
Deposit Type Code 031

USGS Model -- Disseminated Sb deposits

USGS descriptive model 27d for Simple Sb deposits includes quartz-stibnite veins, pods, and disseminations (Bliss and Orris, 1986a). A second accompanying grade-tonnage model is for Disseminated Sb deposits (Bliss and Orris, 1986c). A USGS general descriptive geoenvironmental model for stibnite quartz deposits by Seal, Bliss and Campbell (1995) is applicable to Disseminated Sb deposits.

Description -- quartz-stibnite stockworks and disseminations

The distinction between antimony veins and disseminated antimony deposits is that the veins are mined individually, whereas disseminated antimony deposits may include mineralized breccias, and (or) multiple veins, veinlets, and disseminations, all of which comprise large-tonnage, low-grade ore, which is mined in bulk. In the PNF disseminated antimony deposits tend to be localized along broad fracture zones and (or) dilatant jogs and splays of fault zones.

Interpretation -- stage II mineralization, related to two-mica granite of the Idaho Batholith, and (or) stage VI mineralization, related to the Thunder Mountain Caldera

Quartz and stibnite are components of Stage II and Stage VI paragenetic mineral assemblages of mixed base- and precious-metal veins, as described by Gammons (1988). Late Cretaceous stage II mineralization is associated with vein systems related to late two-mica granite of the Idaho Batholith. Eocene stage VI mineralization is associated with epithermal hot-spring systems related to the Thunder Mountain Caldera.

Examples

Table 2 and appendix B list 1 first-rank, 3 second-rank, and 2 third-rank examples of disseminated antimony deposits in the PNF and vicinity, the locations of which are shown on plate 1 and figs. 20a, b, and c.

Yellow Pine mine: The best known example of a disseminated antimony deposit is exposed in the open pit of the Yellow Pine mine, which is the biggest antimony mine in Idaho. There, stockworks of quartz-stibnite veinlets and disseminated stibnite are localized in highly fractured, silicified and sericitized granite of the Idaho Batholith, on the northwest side of a dilatant jog in the Meadow Creek fault zone. Past production from those deposits was about 31,100 tonnes of antimony (Cooper, 1951; table 9). Assuming this came from the same 2.9 million tonnes of ore as the byproduct gold from the Yellow Pine mine, the average grade of the ore was about 1 wt percent antimony. Silver also was a byproduct.

Rationale for Tract Delineation

The permissive tract for disseminated antimony deposits includes the Idaho Batholith (fig. 5) and ten-km buffer zone around it. The favorable tract for disseminated antimony deposits (figs. 21a, 21b, 21c) coincides with the tract for distal disseminated Au-Ag deposits, and antimony veins. It includes a broad zone of faults, shear zones and veins that spans the eastern margin of the Idaho Batholith and its host rocks. The favorable tract includes the Yellow Pine, Profile, and Edwardsburg mining districts, and the west part of the Big Creek district. The favorable tract is the assessment tract.

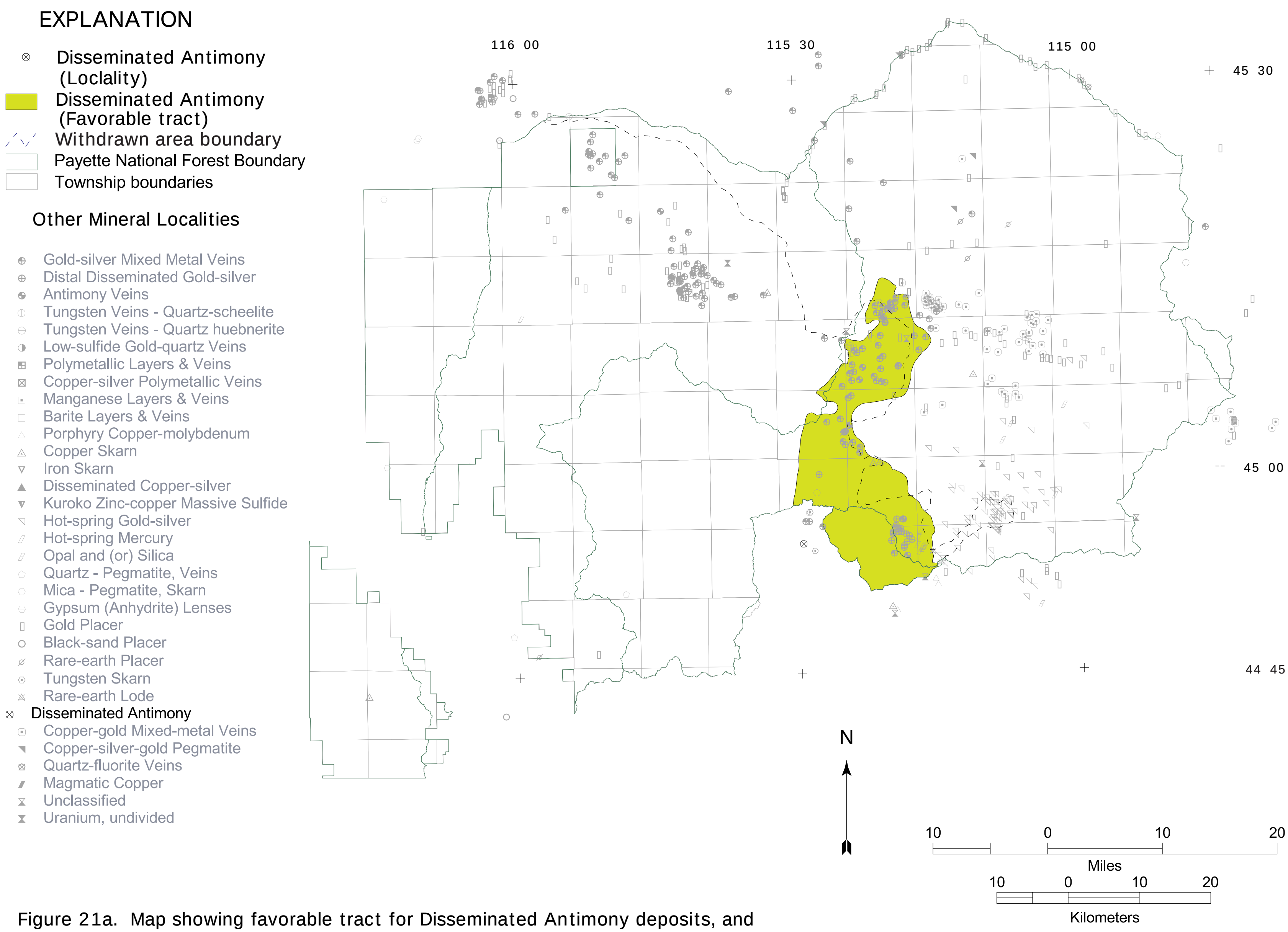


Figure 21a. Map showing favorable tract for Disseminated Antimony deposits, and locality with Disseminated Antimony as a first-rank component, eastern PNF.

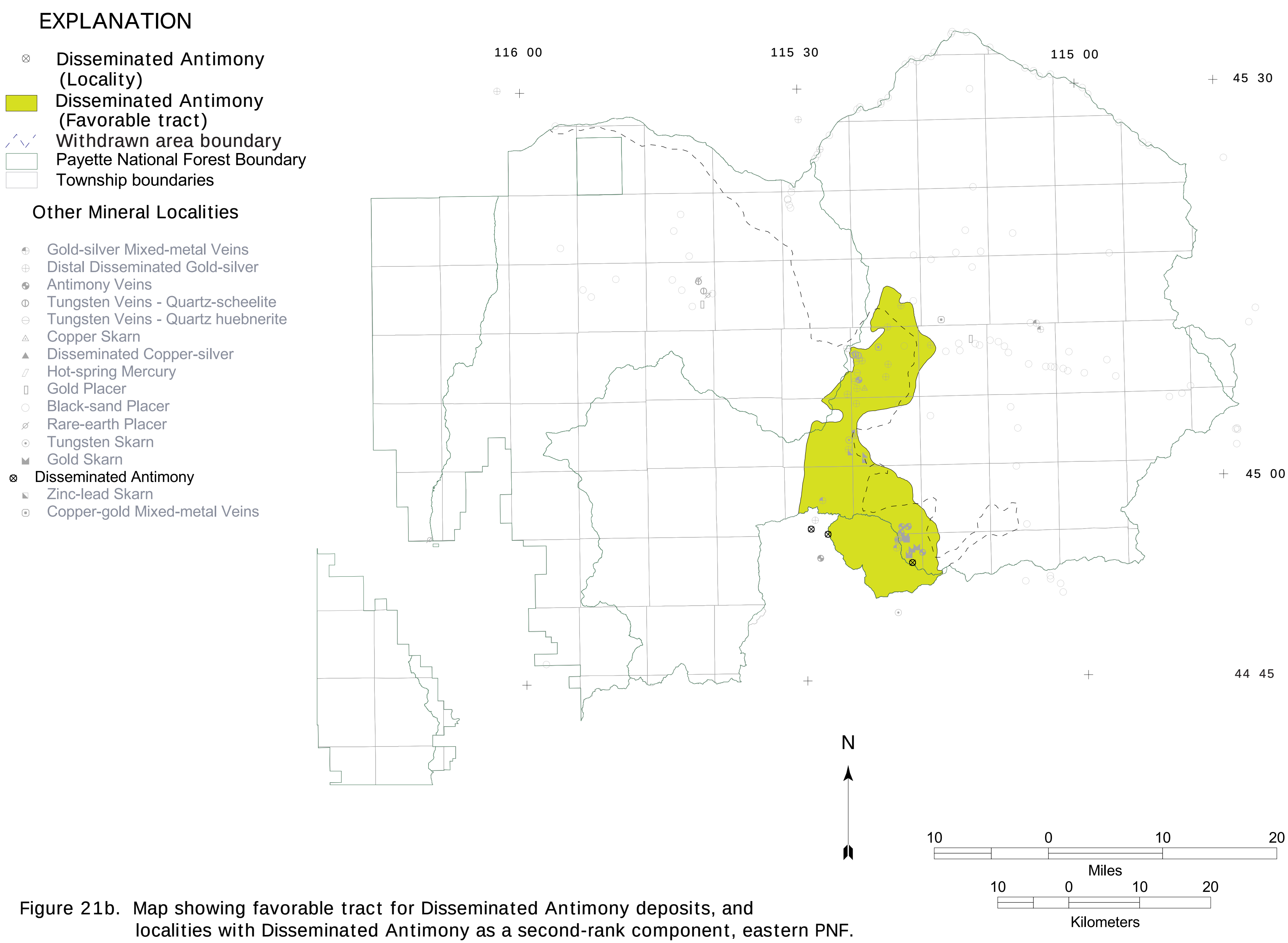


Figure 21b. Map showing favorable tract for Disseminated Antimony deposits, and localities with Disseminated Antimony as a second-rank component, eastern PNF.

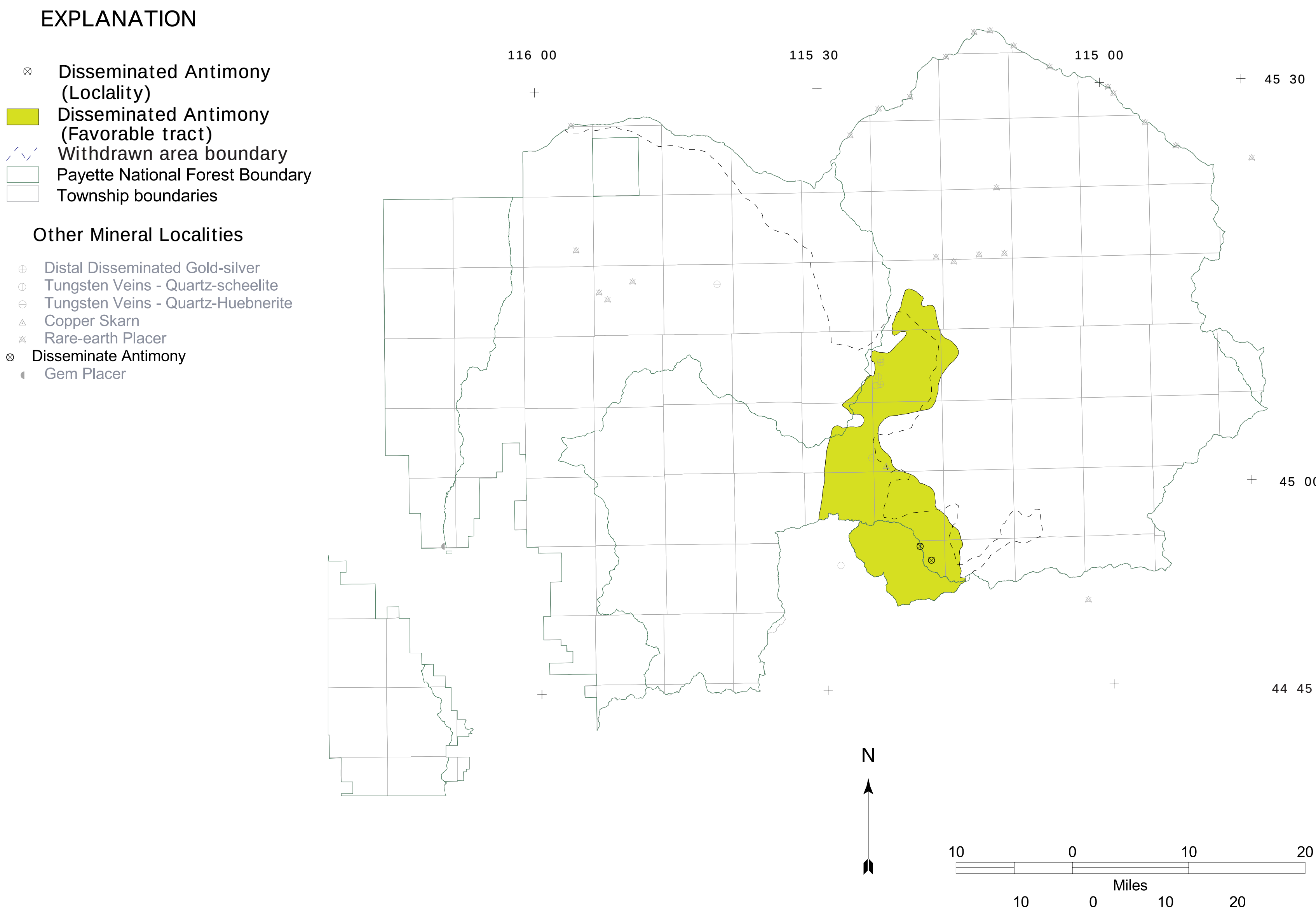


Figure 21c. Map showing favorable tract for Disseminated Antimony deposits, and localities with Disseminated Antimony as a third-rank component, eastern PNF.

Table 12. Disseminated Antimony: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Disseminated Antimony					
Probability	90%	50%	10%	5%	1%
Number of Deposits	0	0	2	3	5

Mark 3 output

Estimate of probability of 0 deposits: 60%

Estimate of probability of the median number of deposits (0): 60%

Estimate of mean expected number of deposits: 0.74

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Disseminated Antimony					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
Antimony	0	0	38,000	14,000	17%
gold	0	0	0	0.0041	10%
ore	0	0	980,000	280,000	19%

Rationale for Numerical Estimation

A grade-tonnage model for disseminated antimony deposits by Bliss and Orris (1986c) is appropriate for estimation of undiscovered stockworks of quartz-stibnite veinlets, as mined from the Yellow Pine pit. That model is based on a set of 23 deposits, for which the median deposit size is 88,000 tonnes. Ten percent of the deposits are smaller than 7,800 tonnes, and ten percent are larger than 990,000 tonnes. The median grade is 3.6 wt percent antimony, but ten percent of the deposits contain less than 1.8 wt percent antimony, and ten percent contain more than 7 wt percent antimony. The Yellow Pine deposit (2.9 million tonnes at 1 wt percent antimony) is larger and lower grade than ninety percent of the deposits included in the model. Nevertheless, the model was considered appropriate for the estimation of undiscovered resources of disseminated antimony.

Numerical estimation of undiscovered deposits was done by target counting and evaluation, and was based on the distribution of known disseminated antimony localities, areas of favorable geology, and consideration of exploration history. Subjective estimates were made of how many targets are likely to fit between the 10th and 90th percentiles of the tonnage and grade models for disseminated antimony deposits. For the 90th, 50th, 10th, 5th and 1st percentiles of subjective probability, the assessment team estimated 0, 0, 2, 3, and 5 undiscovered disseminated antimony deposits. Results of the estimation of undiscovered resources in disseminated antimony deposits are summarized in Table 12.

Development Forecast

The largest use of antimony is in storage batteries, in which 4 to 6 percent antimony is alloyed with lead. Antimony also is used in a number of other applications in the electronic, metallurgical, chemical, military, and medical industries. The waste-rock dump of the Yellow Pine mine would appear to be a potential source of antimony with relatively low mining costs. However, in peace time, markets for antimony are largely satisfied by the combined supply of antimony produced as a byproduct of complex ores, antimony imported from low-cost foreign producers, and recycled antimony. It seems unlikely therefore, that disseminated antimony resources of the PNF will be developed in the foreseeable future.

Environmental Effects and Implications

Most weathering products of stibnite are not readily water-soluble. Nevertheless, water samples from the Yellow Pine mine area contain elevated antimony, arsenic, and sulfate concentrations. Sample ABYP-2, taken from a monitoring well in tailings from the Meadow Creek and Yellow Pine mines had pH = 6.9 and contained 420 ppb antimony, 3,400 ppb arsenic, and 257 ppm sulfate. Sample ABYP-4, taken from the outlet of the pond in the Yellow Pine pit had pH = 8.47 and contained 60 ppb antimony, 76 ppb arsenic, and 9.6 ppm sulfate. Sample ABYP-7, taken from the East Fork of the South Fork of the Salmon River, about 200 m downstream from the waste dumps of the Yellow Pine mine had pH = 7.95 and contained 40 ppb antimony, 67 ppb arsenic, and 13 ppm sulfate.

Tungsten Veins -- Quartz-huebnerite
Deposit Code 005

USGS Descriptive Model -- W veins

USGS descriptive model 15a for W veins (Cox and Bagbey, 1986) is accompanied by a grade-tonnage model for W veins by Jones and Menzie (1986b).

Description -- huebnerite with quartz + fluorite in mixed-metal veins

USGS model 15a (Cox and Bagby, 1986) describes tungsten veins as quartz-wolframite veins, associated with monzogranite to granite stocks that intrude sandstone, shale, and metamorphic equivalents. Huebnerite (Mn-rich wolframite) is present in some Ag-Au mixed metal veins of the Idaho Batholith. According to Gammons (1988), huebnerite is associated with Stage III pyrite, and is enclosed by later sulfides. The quartz-huebnerite component of such veins fits the USGS descriptive model for tungsten veins by Cox and Bagby (1986), but is too minor to fit the USGS grade-tonnage model for tungsten veins by Jones and Menzie (1986b).

Interpretation -- stage III mineralization in veins related to two-mica granite of the Idaho Batholith

Huebnerite is interpreted as a stage-III component of mixed base- and precious-metal veins of the eastern PNF, related to two-mica granite of the Idaho Batholith.

Examples

Table 2 and appendix B list quartz-huebnerite vein material as a deposit-type component at seven localities in the eastern PNF. Six of those localities are in the Edwardsburg mining district, and one is in the Profile mining district. The locations of those localities are shown on plate 1 and figs. 22a, 22b, and 22c.

Edwardsburg district: Four localities with huebnerite as a first-rank component are the McRae mine, Snowbird mine, Red Bluff mine, and Morning Star tungsten prospect. All of these are in the Edwardsburg district, and three of them have subordinate scheelite. Second-rank huebnerite is associated with first-rank scheelite at the White Metal prospect, and with first-rank gold-silver mixed-metal veins at the Antimony Rainbow prospect, both of which are in the Edwardsburg district. Third-rank huebnerite is associated with first-rank gold-silver mixed-metal veins, and second-rank zinc-lead skarn at the Combination prospect, which is in the Profile district.

In the McRae area, huebnerite is present as bladed crystals up to 8 cm long in vein quartz, and as smaller crystals, intergrown with fluorite, disseminated in altered wall rock (Gammons, 1988). Locally, huebnerite is accompanied and (or) partially replaced by scheelite. Weathered huebnerite becomes coated with black manganese oxide.

Rationale for Tract Delineation

The Idaho Batholith and a 10 km buffer zone around it are considered permissive for quartz-huebnerite veins, which are regarded as a subset of gold-silver mixed-metal veins of the Idaho Batholith. Favorable tracts for quartz-huebnerite veins (figs. 22a, 22b, and 22c) are coincident with those for gold-silver mixed-metal veins and for quartz-scheelite veins and breccia-fill deposits.

Reason for no Numerical Estimation

Huebnerite-bearing tungsten veins of the PNF are interesting mineral occurrences, but they are too small to fit the tonnage and grade models for tungsten veins by Jones and Menzie (1986b), so no estimation was made for tonnage and grade of undiscovered resources of this type.

Development Forecast

Huebnerite-bearing veins of the eastern PNF have been prospected and mined on a small scale in the past, but are not expected to be significantly developed in the foreseeable future.

Environmental Effects and Implications

Several small mines and prospects with small waste dumps are present along huebnerite-bearing quartz veins in the McRae and Red Bluff prospect areas. A small accumulation of mill tailings is present at the McRae mill, and drill roads connect the McRae and Red Bluff prospect areas. However, no further environmental disturbances are expected, unless the Red Bluff - Morning Star area is further explored for distal disseminated gold. Exploration drill roads in that area have been reclaimed recently.

Tungsten Veins -- Quartz-scheelite

deposit code 004

USGS Model -- W veins

USGS descriptive model 15a for W veins (Cox and Bagbey, 1986) is accompanied by a grade-tonnage model for W veins by Jones and Menzie (1986b).

Description -- quartz-scheelite veins and breccia-fill deposits

Quartz-scheelite veins and breccia-fill deposits are present in granitic rocks of the Idaho Batholith. Quartz-scheelite veins are tabular quartz veins that contain scheelite. Quartz-scheelite breccia-fill deposits contain granitic fragments that are variously cemented and (or) replaced by quartz and scheelite ± calcite. Such mineralized breccias tend to be localized in dilational breccias that occupy northeast-striking dilational fault jogs and (or) dilational fault-splay intersections. Textural observations and interpretations by Cooper (1951) and Cookro (1985) indicate that mineralization occurred in three stages, which produced: 1) early disseminated arsenopyrite, 2) quartz-scheelite veins and breccia-fill deposits, and 3) stibnite veins. For this sequence to fit the paragenetic sequence described by Gammons (1988) the disseminated arsenopyrite would represent Stage I, the scheelite would represent Stages III and (or) V, and the stibnite would represent Stage VI mineralization.

Quartz-scheelite veins and breccia-fill deposits of eastern PNF do not fit the USGS descriptive model for quartz-wolframite tungsten veins by Cox and Bagby (1986), but they do fit the USGS tungsten-vein tonnage and grade models by Jones and Menzie (1986b).

Interpretation -- Scheelite of batholith-related stage III and post-batholith stage V

Scheelite of paragentic stage III (74 Ma) is present in some Au-Ag mixed-metal veins related to late two-mica granite of the Idaho Batholith. However, scheelite in the larger and more important quartz-scheelite breccia-fill deposits belongs to stage V mineralization (57-53 Ma), which is younger than dated parts of the Idaho Batholith, but older than dated Eocene intrusions and (or) volcanic rocks of the eastern PNF. The quartz-scheelite breccia-fill deposits may be related to an unexposed granite related to the Idaho Batholith, and (or) to hydrothermal fluids, heated by post-magmatic cooling of the batholith.

Examples

Table 2 and appendix B list quartz-scheelite at 13 localities in the eastern PNF, in the Marshall Lake, Warren, Edwardsburg, Profile, and Yellow Pine mining districts. These localities are shown on plate 1 and figs. 22a, 22b, and 22c). At six of these localities, quartz-scheelite is a first-rank component, at five a second-rank component, and at two a third-rank component.

Quartz-scheelite veins: First-rank quartz-scheelite vein deposits are associated with huebnerite at the White Metal prospect, gold-silver mixed-metals at the Morning Star and Quartz Creek localities, and copper-gold mixed-metals at the Rocket prospect. Second-rank quartz-scheelite vein deposits are associated with quartz-huebnerite veins at the McRae, Snowbird, and Red Bluff mines, and gold-silver mixed-metal veins at the Charity and Unity mines in the Warren district. Second-rank quartz-scheelite breccia-fill deposits are associated with distal disseminated gold-silver deposits at the Yellow Pine Mine. Third-rank quartz-scheelite vein deposits are associated with gold-silver mixed-metal veins at the Ludwig prospect, and with tungsten skarn and antimony veins at the Pioneer Group prospect.

Quartz-scheelite breccia-fill deposits: Quartz-scheelite breccia-fill deposits are present at the Yellow Pine and Golden Gate mines in the Yellow Pine district, and the Quartz Creek mine in the Profile district. Cookro (1985) described the breccias and breccia-fill deposits of those mines as follows. At the Quartz Creek mine, biotite-muscovite granite is broken, with only slight rotation of clasts, and the breccia is fragment-supported. At the Yellow Pine mine, porphyrytic muscovite-biotite granite has rotated clasts, but in many places, the clasts can be imagined to fit back together in a “jigsaw-puzzle fashion.” Breccia in porphyritic granite at the Golden Gate mine is more chaotic and has randomly oriented clasts of porphyritic granite. Quartz $\pm$ scheelite $\pm$ calcite fill extensional veins, spaces between granitic clasts, and cavities formed by dissolution of feldspar. “Where quartz-scheelite veins are in contact with carbonate inclusions in the batholith, replacement textures are prominent” (Cookro, 1985, p. 194).

Rationale for Tract Delineation

The Idaho Batholith (fig. 5) and a 10 km buffer zone around it are considered permissive for quartz-scheelite veins and breccia-fill deposits, which are regarded as a subset of gold-silver mixed-metal veins of the Idaho Batholith. Favorable tracts for quartz-scheelite vein and breccia-fill deposits (fig. 22a, 22b, 22c) are coincident with favorable tracts for quartz-huebnerite veins and Au-Ag mixed-metal veins of the Idaho Batholith. The assessment tract includes both favorable tracts as subunits.

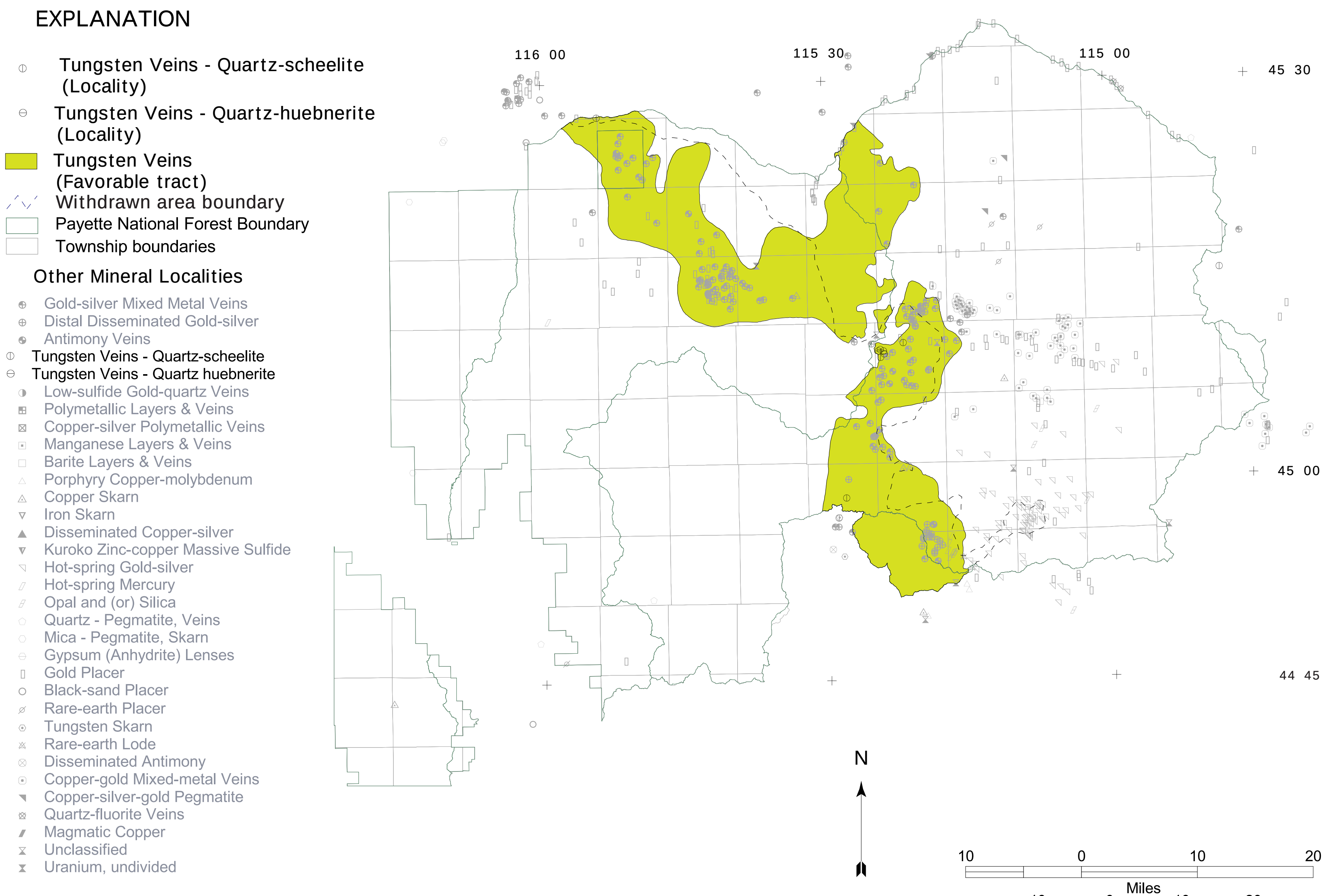


Figure 22a. Map showing favorable tracts for Tungsten Veins, and localities with tungsten as a first-rank component in veins, eastern PNF.

EXPLANATION

- Tungsten Veins - Quartz-scheelite (Locality)
- Tungsten Veins - Quartz-scheelite (Locality)
- Tungsten Veins (Favorable tract)
- Withdrawn area boundary
- Payette Nationa Forest Boundary
- Township boundaries

Other Mineral Localities

- Gold-silver Mixed-metal Veins
- Distal Disseminated Gold-silver
- Antimony Veins
- Tungsten Veins - Quartz-scheelite
- Tungsten Veins - Quartz huebnerite
- Copper Skarn
- Disseminated Copper-silver
- Hot-spring Mercury
- Gold Placer
- Black-sand Placer
- Rare-earth Placer
- Tungsten Skarn
- Gold Skarn
- Disseminated Antimony
- Zinc-lead Skarn
- Copper-gold Mixed-metal Veins

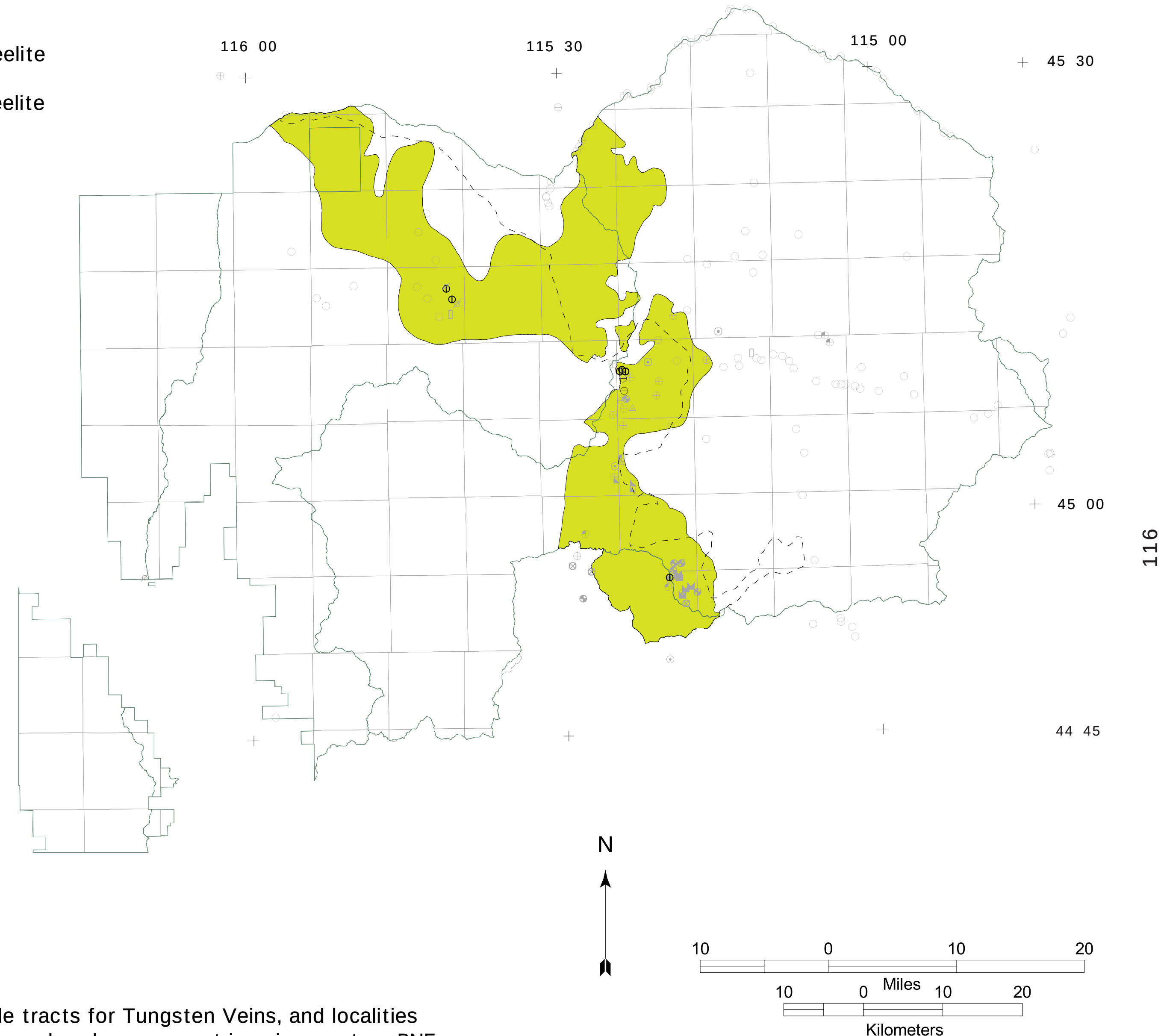


Figure 22b. Map showing favorable tracts for Tungsten Veins, and localities with tungsten as a second-rank component in veins, eastern PNF.

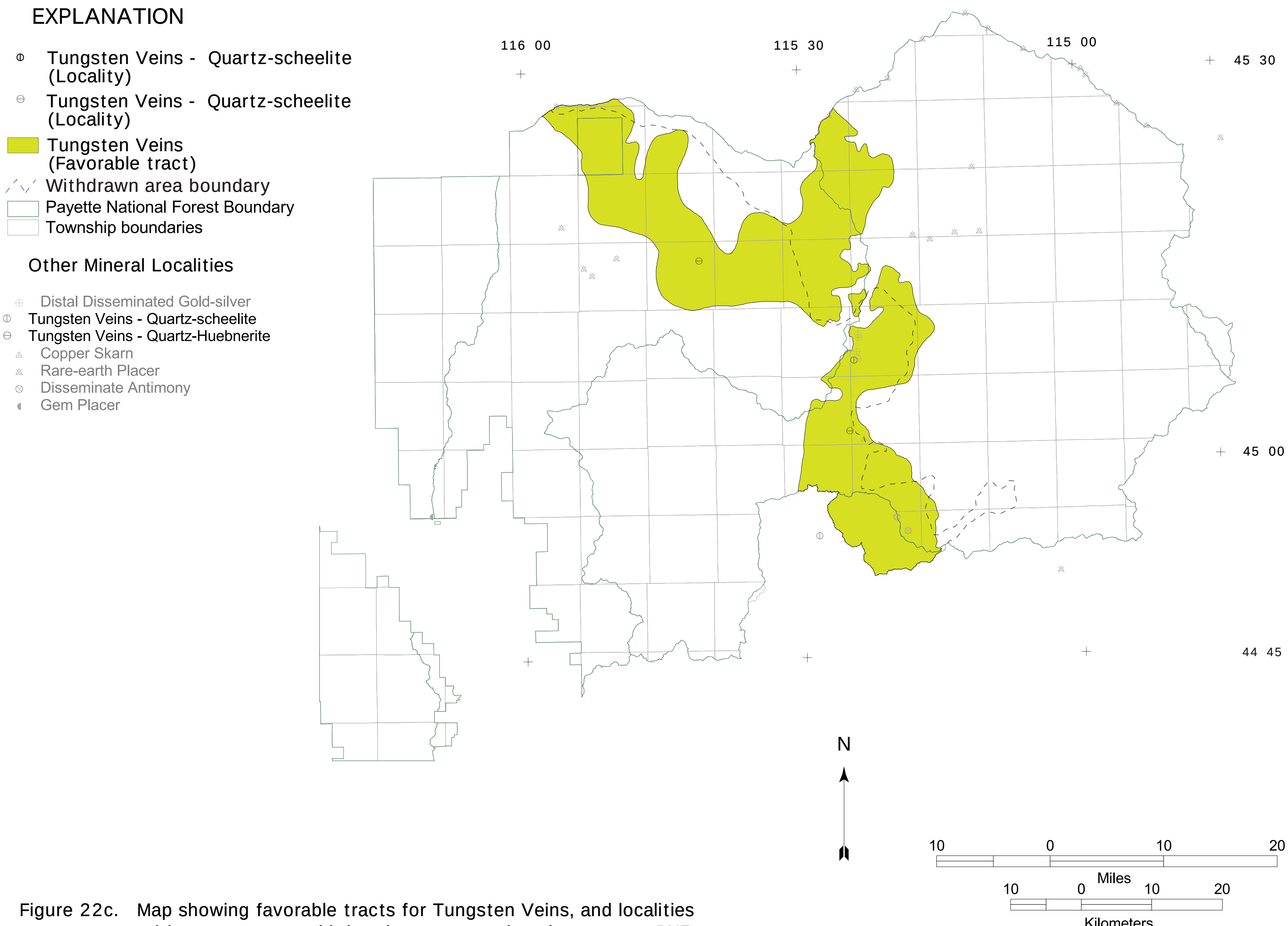


Figure 22c. Map showing favorable tracts for Tungsten Veins, and localities with tungsten as a third-rank component in veins, eastern PNF.

Table 13. Tungsten Veins: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Tungsten Veins (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	1	2	3	5

Mark 3 output

Estimate of probability of 0 deposits: 31%

Estimate of probability of the median number of deposits (1): 39%

Estimate of mean expected number of deposits: 1.1

Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Tungsten Veins (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
tungsten trioxide	0	3,400	73,000	25,000	24%
ore	0	400,000	10,000,000	3,200,000	22%

Rationale for Numerical Estimation

The Yellow Pine mine produced about 7,850 tonnes of WO_3 from about 600,000 tonnes of ore, the average grade of which was about 1.3 wt percent WO_3 (table 9). That tonnage is near the median for tungsten vein deposits, and the grade is near the 90th percentile for grade in such veins, according to the tonnage and grade models for tungsten veins by Cox and Bagby (1986). Use of the tonnage and grade model for tungsten veins is therefore justified to estimate the size and grade of similar undiscovered deposits in the PNF.

Numerical estimation of undiscovered deposits was based on the distribution of known mines, prospects and occurrences, and areas of favorable geology. The mature status of exploration history and the extent of surficial cover also were taken into account. For the 90th, 50th 10th, 5th and 1st percentiles of subjective probability, the team estimated 0, 0, 2, 3, and 5 undiscovered deposits that would range in size and grade between the 90th and 10th percentiles of the tonnage-grade model for tungsten veins by Cox and Bagby (1986). Results of the estimation of undiscovered resources in tungsten veins are summarized in Table 13.

Development Forecast

Tungsten deposits of the PNF seem to be of economic interest only during wars and (or) threats of war, when world markets are disrupted and (or) the government subsidizes the price of tungsten. Without unforeseen increases in the price of tungsten trioxide, it is unlikely that there will be significant exploration for or development of tungsten resources of the PNF, except perhaps where they may be associated with distal disseminated gold mines or prospects.

Environmental Effects and Implications

Quartz-scheelite veins and breccia-fill deposits contain little pyrite, and probably have little acid-generating potential, except if they are associated with mixed-metal veins and (or) distal disseminated Au-Ag deposits, as at Yellow Pine. Otherwise, environmental effects of existing quartz-scheelite veins and breccia-fill deposits probably are mostly limited to existing physical disturbances, related to small mines and prospects.

Uranium Lode

deposit code 046

Only one uranium-bearing lode occurrence is known to be present within PNF (fig. 23). It is the Red Ledge Number 6 occurrence, in the Warren mining district (pl. 1, locality no. 495). The USGS Mineral Resources Data System lists uranium and rare-earth elements as potential commodities, and indicates that detectable radioactivity is localized along a north-striking, vertically dipping zone in metasedimentary schist and limestone. Inasmuch as the uranium lode is spatially associated with Au-Ag mixed-metal veins of the Warren mining district, we suggest that the uranium may be genetically related to mixed-metal veins of the Idaho Batholith.

Mineral Deposits of the Thunder Mountain Cauldron Complex and Vicinity

The Thunder Mountain Cauldron Complex, in the southeastern part of the PNF, is a volcanic collapse feature along the northwestern margin of the Challis Volcanic Field (fig. The volcanic field and cauldron complex are Eocene in age, and consist of subaerial volcanic and volcaniclastic rocks of intermediate to felsic composition. The cauldron complex is bounded by northeast-striking normal faults, which parallel the regional trans-Challis fault system and the Pilot Creek dike swarm. Isotopic age determinations by Leonard and Marvin (1982) indicate that volcanism of the Thunder Mountain Cauldron complex began at about 48 to 47 Ma with the eruption of rhyodacitic ash-flow tuff. Subsequent eruptions at 46 Ma produced rhyolite and ash-flow tuff, informally named the Sunnyside Tuff (Fisher and Johnson, 1995b) or the Sunnyside sequence (Parsely, 1997). After subsidence that resulted from these eruptions, fine-grained lacustrine sediments and intercalated volcanic mudflow debris were deposited to form the informally named beds of the Dewey mine (Fisher and Johnson, 1995b) or the Dewey sequence (Parsley, 1997).

Hot-spring gold-silver mineralization in the Thunder Mountain Cauldron Complex occurred about 43 m.y. ago, as indicated by K-Ar dating of adularia from the Sunnyside deposit (Adams, 1985). Hot-spring gold-silver deposits are localized along silicified and argillized fault zones and permeable layers within the Thunder Mountain Cauldron Complex. These mineralized rocks are overlain by unmineralized vesicular latite lava flows with cinder layers and volcanic bombs (dated 43 to 41 Ma by Leonard and Marvin, 1982).

Opal and silica occurrences also are present in altered volcanic and volcaniclastic rocks of the cauldron complex. Rare-earth occurrences are present in cauldron-bounding fault zones. Hot-spring mercury deposits are localized along fault zones in metasedimentary marble layers peripheral to the cauldron complex.

Hot-spring Gold-silver
deposit code 018

USGS model -- Hot-spring Au-Ag

USGS descriptive model 25a for Hot-spring Au-Ag deposits (Berger, 1986b) corresponds to a grade and tonnage model by Berger and Singer (1992).

Description -- disseminated Au-Ag deposits, in or near volcanic fields with lacustrine volcaniclastic interbeds

Hot-spring Au-Ag deposits are disseminated (bulk-mineable) Au-Ag deposits that are in or near subaerial volcanic fields with lacustrine volcaniclastic interbeds. Surficial expressions of hot-spring Au-Ag deposits include siliceous hot-spring sinters and breccias. Subsurface expressions of hot-spring Au-Ag plumbing systems are zones of silicified, argillized, and mineralized rocks, localized along faults, fracture zones, and adjacent permeable volcaniclastic rocks. Some hot-spring Au-Ag deposits, including those of the eastern PNF, contain disseminated gold ± electrum, pyrite, stibnite, realgar, and cinnabar (Berger, 1986b).

In the Thunder Mountain cauldron complex, gold-silver deposits and soil geochemical anomalies for arsenic, antimony, and mercury correspond to felsic volcanic and volcaniclastic rocks that contain chalcedonic silica, minor adularia, and abundant clay (illite and montmorillonite). These hydrothermal products are localized along steeply-dipping faults and fractures, and gently-dipping layers of volcaniclastic rocks.

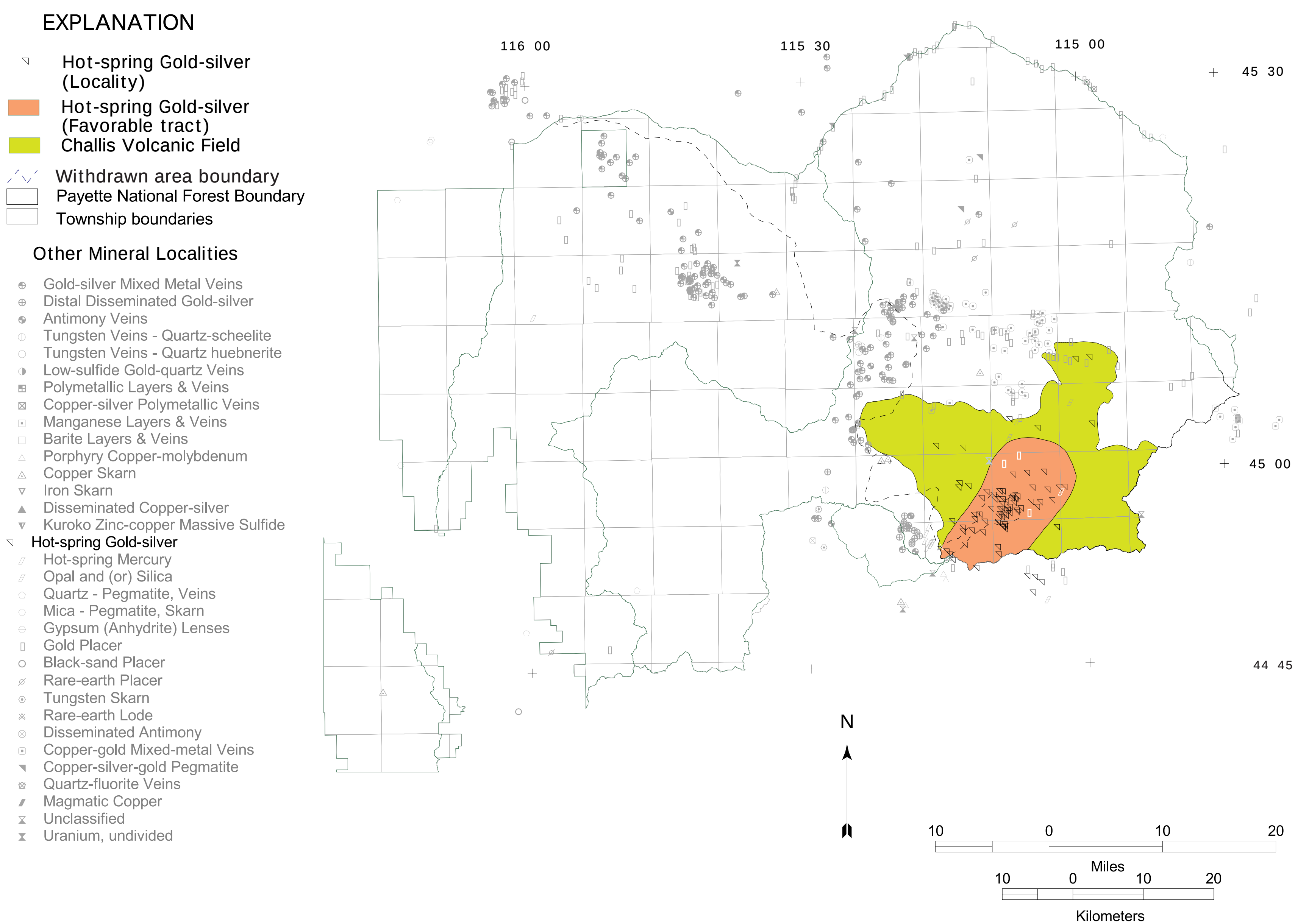


Figure 23. Map showing localities and favorable tract for Hot-spring Gold-silver deposits, eastern PNF. The favorable tract coincides with the Thunder Mountain Cauldren complex. The permissive tract includes the Challis Volcanic Field in the PNF, and a 10-km buffer zone around it.

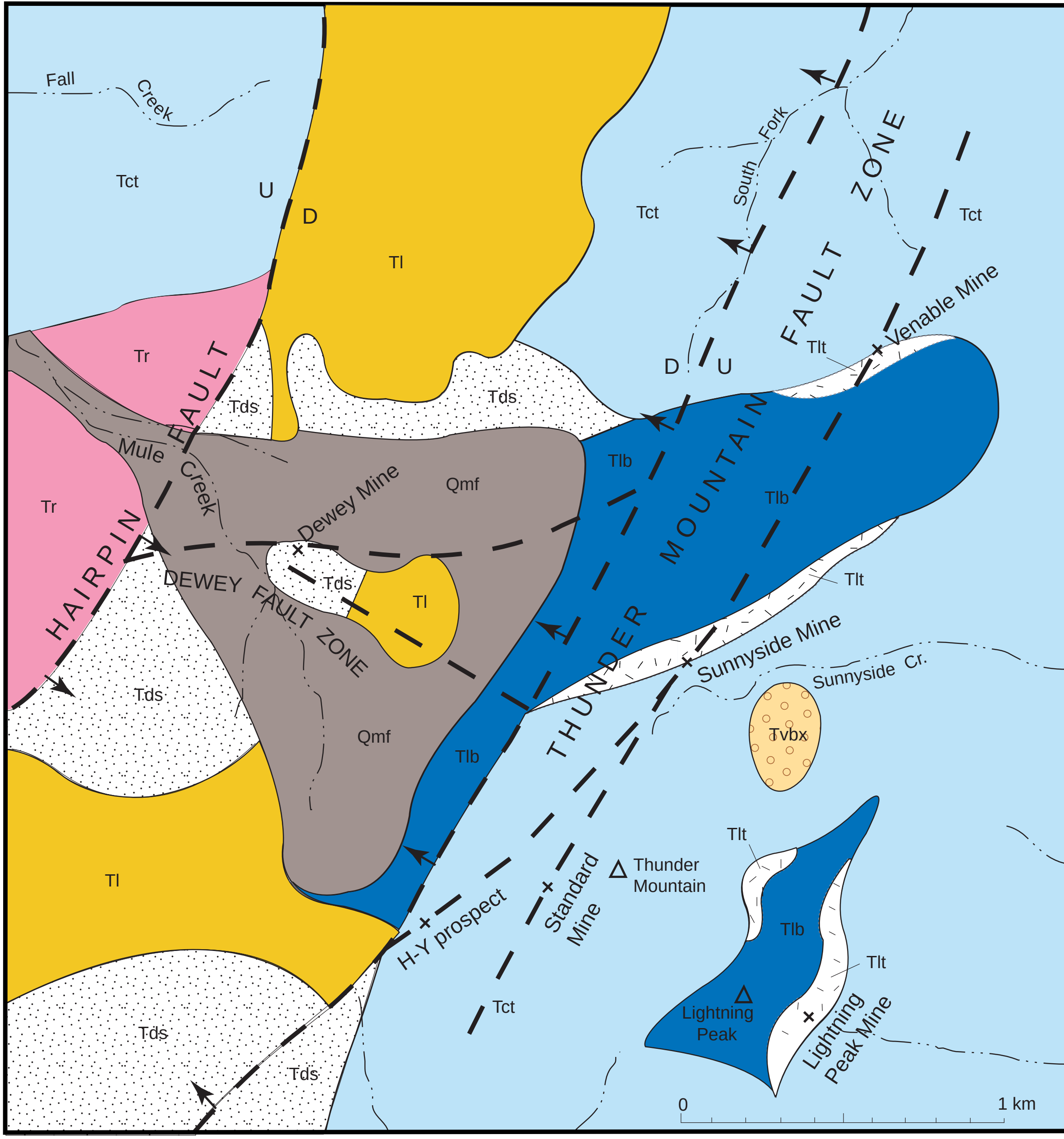


Figure 24. Diagrammatic geologic map of the area of the Sunnyside and Dewey mines, Thunder Mountain mining district, eastern PNF [from USFS, Thunder Mtn. (Sunnyside) mining project study area report; PNF Newsletter, 1996; and Parsley, 1997].

Table 14. Thunder Mountain mining district: Production, reserves, and resources of Hot-springs Gold-silver deposits

			Production (tonnes)		**Mineable Reserve (tonnes)**		**Resource (tonnes)**		
Time Interval	**Mine**	**Deposit Type**	**Au**	**Ag**	**Au**	**Ag**	**Au**	**Grade**	**Operator**
1894 -1909	**Dewey**	Hot-springs Gold-silver	0.71	0.37					Caswell Bros., placer and lode
1885 -1907	**Sunnyside**	Hot-springs Gold-silver	0.14						McRae and Davis, placer and lode
1910 -1942	**Dewey**	Hot-springs Gold-silver	0.06	0.50				10 ppm Au	Golden Reef Mining Co., lode (10 ppm Au)
1981 -1984	**Dewey**	Hot-springs Gold-silver	0.16	0.31					Golden Reef Joint Venture
1986 -1990	**Sunnyside and Lightning Peak**	Hot-springs Gold-silver	2.60	3.60			3.2	1 to 3 ppm Au	Coeur d'Alene Mines
1997 - future	**Dewey**	Hot-springs Gold-silver			7.8	15.6	8.8	1.5 to 1.6 ppm Au	Dakota Mining
		Total	3.67	4.78	7.8	15.6	12.0		

(data converted to metric units from USMX, 1997; USBM, 1996; Shannon and Reynolds, 1975; Adams, 1985)

Interpretation -- epithermal Au-Ag deposits, formed in hot-spring systems related to subaerial volcanism in pluvial environments

Hot-spring Au-Ag deposits of the Thunder Mountain district are interpreted as epithermal deposits that formed in the shallow subsurface of hot-spring vent systems, localized by steeply dipping faults and adjacent permeable volcaniclastic layers. Some of these volcaniclastic layers are interpreted as alluvial and lacustrine deposits, which indicate a pluvial environment in which geothermal water was largely of atmospheric derivation. Surficial hot-spring sinter is absent and is presumed to have been removed by erosion.

In the shallow subsurface beneath hot-spring vents, silica, adularia, clay, Au- and Ag-bearing minerals were deposited by interaction of geothermal fluids (mostly hot water and steam), with host rocks and meteoric water, as the fluids moved along steeply-dipping faults and fractures, and penetrated laterally into adjacent layers of relatively permeable volcaniclastic host rocks.

Examples

Locations of 80 hot-spring gold-silver mines, prospects, and occurrences, all of which are hosted in Eocene volcanic rocks of the Thunder Mountain Cauldron Complex, are shown on plate 1 and listed in appendices A and B. The Sunnyside, Lightning Peak, and Dewey mines have known production and (or) resources, as summarized in table 14.

The Sunnyside, Venable, and Standard mines, and the H-Y prospect are localized along strands of the northeast-striking Thunder Mountain fault zone. The Sunnyside, Venable, and Lightning Peak mines are in relatively permeable lapilli tuff of the Sunnyside Sequence, beneath impermeable volcanic mudflow (lahar) deposits (lithic breccia of fig. 24). The Dewey mine is localized in and around strands of the Dewey fault zone, which crosses a northeast-trending graben between the Hairpin fault and the Thunder Mountain fault zone. The Dewey deposit is best developed in relatively permeable volcaniclastic sedimentary rocks of the Dewey sequence, in the graben (fig 24).

Sunnyside mine: The Sunnyside mine is near the head of Sunnyside Creek, a tributary to Marble Creek (fig. 23). The Sunnyside underground mine operated from 1885 to 1907, producing relatively high-grade gold-silver ore from the northeast-striking Thunder Mountain fault zone, where the steeply dipping fault intersected gently dipping non-welded tuff, beneath an impermeable cap of blue-gray clay, and silicified lithic breccia (Umpleby and Livingston, 1920; Shenon and Ross, 1936; Adams, 1985; Johnson and Fisher, 1995). Adams (1985) obtained a K-Ar age determination of 43 Ma from hydrothermal adularia associated with Au-Ag mineralization at the Sunnyside mine. Early adularia was followed by several stages of silicification, and late clay alteration plus native gold and electrum (Adams, 1985).

The Sunnyside open-pit mine, which operated from 1986 to 1990, excavated a discontinuous blanket of mineralized rock in the upper part of a permeable non-welded lapilli tuff in the upper part of the Sunnyside sequence (fig 24). The ore zone ranged from 3 to 27 m thick, dipped gently northwest, and consisted of stratabound and fracture-controlled lenses and pods of hydrothermally altered and mineralized tuff, capped by about 0 to 15 m of impermeable blue-gray clay and (or) silicified lithic breccia (Adams, 1985), interpreted here as volcanic mudflow (lahar) deposits.

Coeur d'Alene Mines Co. recovered about 2.6 tonnes of gold from an announced resource of 5.8 tonnes of gold at the Sunnyside open-pit mine. This implies a remaining resource of 3.2 tonnes of gold, as shown in table 14. Some of the remaining resource probably lies beneath heap leach piles that were placed on patented land, and some of the remaining resource probably resides in spent ore from early heap-leach operations, which achieved poor recovery from ore that was not crushed or agglomerated. The open-pit mine and spent-ore piles were reclaimed in 1991.

Lightning Peak mine: The Lightning Peak open-pit mine is on the upper southeast slope of Lightning Peak, about 1.2 km southeast of the Sunnyside mine area. It was excavated as part of Coeur d'Alene Mines Sunnyside project. The orebody was hosted in argillized non-welded lapilli tuff beneath black, muddy conglomerate and silicified lithic breccia, interpreted here as volcanic mudflow (lahar) deposits.

Dewey Mine: The Dewey mine is about 1.2 km west-northwest of the Sunnyside mine, on Dewey Hill (a ridge spur that stands about 500 ft above its surroundings), near the head of Mule Creek, a tributary to Monumental Creek. Shenon and Ross (1936) described Dewey Hill as a prominent outcrop of alluvial and (or) lacustrine volcaniclastic sandstone, with interbeds of shale and conglomerate, and a few thin layers of impure lignite. They stated that wood and plant fragments are very abundant, and some large logs contained much free gold. Early workings consisted of surface excavations (made mainly by sluicing unconsolidated surficial materials), and about 2,000 ft of underground workings on two main levels and several intermediate levels, extending through a vertical range of about 75 m (Shenon and Ross, 1936).

At the Dewey mine, disseminated gold and electrum are hosted in tuffaceous epiclastic sedimentary rocks of the informally named Dewey sequence, which also includes interbeds of ash-fall tuff and black agglomeratic mudflow deposits (Parsley, 1997). The tuffaceous sedimentary rocks are interpreted as lacustrine and (or) fluvial sediments, and the black agglomerate is interpreted as a laharic (volcanic mudflow) deposit, similar to those that overlie Sunnyside Tuff at the Sunnyside and Lightning Peak deposits. Tuffaceous sediments of the Dewey sequence are overlain by post-ore latite flow rocks of Lookout Mountain (dated 43 to 41 Ma by Leonard and Marvin, 1982).

At the Dewey mine, volcano-sedimentary strata of the Dewey sequence are preserved in a graben between the Thunder Mountain and Hairpin fault zones, both of which strike northeast and dip steeply (parallel to the trans-Challis fault system). The Dewey deposit is localized along the Dewey fault zone, which strikes northwest across the graben, and dips steeply. Ore zones follow the fault, and extend outward from it along permeable beds of black agglomerate and tuffaceous sediments (Parsley, 1997). Gold and electrum (950 to 550 fine) are mostly fine-grained (50 microns to 1 mm), and are concentrated in seams, cracks, and bedding plane laminations (Parsely, 1997; Johnson and Fisher, 1995). Parsley (1997) described evidence for three hydrothermal alteration events at the Dewey deposits: (1) early silicification of lithic tuff and tuffaceous sediments of the upper Dewey sequence; (2) argillization; (3) late silicification in the form of chalcedonic quartz $\pm$ adularia $\pm$ gold-silver mineralization.

Drill-indicated gold-silver resources and mineable reserves of the Dewey deposit are summarized in table 14. The mineable reserves are contained in about 4.8 million tonnes of ore, with an average waste-to-ore ratio of 0.59 to 1. This implies a total of about 7.7 million tonnes of rock to be excavated (Parsely, 1997). A proposal has been submitted to PNF by USMX (now Dakota Mining) to mine the deposit and recover gold and silver by heap-leach cyanidation (USMX, 1997).

Other mines and prospects: The Venable mine, Standard mine, and H-Y prospect are localized along the northeast trending Thunder Mountain fault zone (fig. 23). Kirwin and Hubbard (1984) found geochemically anomalous gold, silver, mercury, antimony and arsenic at the Venable claim group. They reported that gold mineralization is controlled by fracture zones in silicified and argillized crystal-rich tuff.

The Bold Ruler and Safety Creek prospects are about 2.5 km east of the Sunnyside deposit, on the east side of Marble Creek. Lambeth and Iverson (1987) reported that the Bold Ruler prospect is a fracture-controlled epithermal gold occurrence in tuffaceous host rock similar to that of the Sunnyside mine. Results of their surface geochemical survey indicated two gold-exploration target areas, one of 2-hectare, and one of 10-hectare size.

Rationale for Tract Delineation

Challis volcanic rocks (fig 23) and a 10 km buffer zone around them are considered permissive for hot-spring gold-silver deposits. The favorable tract is defined by the area of highest concentration of mines, prospects and occurrences, which are clustered within and around the northeast-trending graben between the Thunder Mountain fault zone and the Hairpin fault (figs. 23 and 24). The favorable tract is the assessment tract.

Rationale for Numerical Estimation

Numerical estimation of undiscovered deposits was done by target counting and evaluation, and was based on the distribution of known hot-spring gold-silver localities, areas of favorable geology, geochemical anomalies, and consideration of exploration history. Subjective estimates were made of the number of targets likely to fit between the 10th and 90th percentiles of the tonnage and grade models for hot-spring gold-silver deposits by Berger and Singer (1992). For the 90th, 50th 10th, 5th and 1st percentiles of subjective probability, the team estimated 0, 1, 1, 2, and 3 undiscovered deposits consistent with the tonnage and grade models of Berger and Singer (1992). Results of the estimation of undiscovered resources in hot-spring gold-silver deposits are summarized in table 15.

Development Forecast

An initial plan of operations to mine the Dewey deposit was submitted in 1997 with the hope that mining could begin in 1998 (USMX, 1997). The mine would be an open-pit mine. The ore would be crushed and agglomerated, and gold-silver would be recovered by heap-leaching with dilute cyanide solutions. Anticipated mine life through closure would be 8 to 10 yrs (mining 5 to 6 yrs, process production 2 yrs, reclamation 2 yrs). The operation would employ about 75 to 100 people.

Exploration for and development of other hot-spring gold-silver discoveries is expected only within the relatively small area around the Sunnyside and Dewey deposits that is not within the Frank Church - River of No Return Wilderness. There is a good possibility that relatively high-grade gold-silver feeder-vein zones exist beneath the Dewey deposit as it is presently known. Such deposits would have the potential to support underground mining after depletion of the Dewey open pit mine.

Table 15. Hot-spring Gold-silver: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Hot-spring Gold-silver (simulator input)					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	1	1	2	3

Mark 3 output

Estimate of probability of 0 deposits: 30%
Estimate of probability of the median number of deposits (1): 63%
Estimate of mean expected number of deposits: 0.80
Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Hot-spring Gold-silver (simulator output)					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
gold	0	11	98	39	19%
silver	0	0	400	130	12%
ore	0	7,200,000	60,000,000	26,000,000	19%

Environmental Effects and Implications

In four water samples taken from mine workings and monitoring wells in the Thunder Mountain district in August and September, 1994, pH ranged from 4.7 to 6.8, and dissolved sulfate concentrations ranged from 25 to 93 ppm. Dissolved zinc concentrations ranged from 10 to 300 ppb Zn. Dissolved copper, cadmium, cobalt, nickel, lead, uranium, beryllium, and mercury concentrations were each less than 10 ppb. Dissolved arsenic and antimony contents ranged from < 2 to 22 ppb As, and from 0.2 to 20 ppb Sb.

Open-pit mining of oxidized ores of the Dewey deposit will result in truncation of the west end of the Dewey Hill ridge spur, and excavation of a roughly circular pit, about 350 m across, at the base of the remaining ridge spur. Waste rock would be stored on the northeast side of Dewey Hill, at the upper end of the drainage basin of the north fork of Mule Creek. Primary ores probably contained sparse, fine-grained pyrite, which weathered to produce yellowish jarosite and orange-brown limonite stains on rocks in the oxide zone. Oxidized Au-Ag ores, amenable to heap leaching with cyanide, contain little acid-generating pyrite or other sulfides.

If only oxidized ore and waste rock are mined, mine drainage will probably not be strongly acidic, and dissolved metal contents will not be very high, even though silicified and argillized host rocks probably have low acid-buffering capacity. Nevertheless, fine-grained hydrothermal clay and limonitic weathering products will be exposed on the surfaces of broken and crushed rocks on the waste-rock piles, and this may lead to downslope and downstream transport and deposition of fine-grained, limonitic sediment with anomalous concentrations of arsenic and mercury, which are geochemically associated with gold and silver in mineralized rocks of the Thunder Mountain district.

Careful consideration should be given to the stability of slopes on which mine wastes are to be stored in upper Mule Creek, because of “the rather peculiar landslide which dammed Monumental Creek and flooded the little town of Roosevelt [in 1909]. This landslide started near the head of Mule Creek south of the Dewey mine at a point about two miles from Monumental Creek, and moved slowly down to Monumental Creek, damming the valley to a depth of about 28 feet overnight” (Umpleby and Livingston, 1920, p. 5). The area of the 1909 landslide or mudflow (Qmf in fig. 24) should be carefully studied and compared to the proposed waste-rock storage site. If the areas are similar, engineering precautions should be taken (such as drainage or removal of unstable material) to prevent landslides during or after storage of the waste rock.

Water for the Dewey mine operation would be stored in a pond to be built in the old Sunnyside Pit. A heap-leach pad would be placed at the site of leach pads for the previous Sunnyside operation, on the broad ridge northeast of the Sunnyside Pit (USMX, 1997). Cyanide solutions used in heap leaching would have to be effectively contained during mineral processing and destroyed during closure and reclamation operations.

Hot-spring Mercury
Deposit Code 019

USGS models -- Hot-spring Hg

Descriptive model 27a for Hot-spring Hg deposits (Rytuba, 1986a) is accompanied by a grade and tonnage model by Rytuba (1996b). A descriptive geoenvironmental model for silica-carbonate Hg deposits was written by Rytuba and Kleinkopf (1995).

Description -- cinnabar + chalcedonic silica, hosted in fractured metasedimentary rocks, near a volcanic field

Hot-spring Hg deposits contain cinnabar (red HgS), with pyrite and (or) marcasite ± rare stibnite, realgar, and (or) orpiment. Surficial hot-spring vent sinter contains cinnabar disseminations and fracture coatings. Vent sinter is underlain by steep, upward-branching feeder systems of cinnabar-bearing veins, veinlets, disseminations, and fracture coatings.

Most Hot-spring Hg deposits in the southeast part of the eastern PNF are present in the Cinnabar camp and Stibnite mining areas. There they are hosted in limestone, dolomite and argillite that are metamorphosed to tremolite skarn and biotite hornfels in a large roof pendant of metasedimentary rocks in the Idaho Batholith, and near the Thunder Mountain Cauldron Complex of the Challis Volcanic Field. Cinnabar is present in chalcedonic veins and veinlets, fracture coatings, cavity linings, and disseminations near fractures. Pyrite and minor realgar and orpiment accompany the cinnabar.

Interpretation -- epithermal Hg, deposited below hot springs related to volcanism

Hot-spring Hg deposits are deposited near the paleo ground-water table in areas of fossil hot-spring systems, mostly related to volcanism of mafic to intermediate composition (Rytuba, 1986). However, those of the Cinnabar Camp-Stibnite area probably are related to intermediate to the Challis Volcanic Field, of intermediate to felsic composition.

Examples

The Hermes and Fern mercury deposits are hosted in limestone and dolostone layers in a roof-pendant of metasedimentary rocks, surrounded by granitic rocks of the Cretaceous Idaho Batholith (fig. 18). This is the same roof pendant of metasedimentary rocks that hosts distal disseminated gold-silver deposits in the nearby Stibnite mining area. The Hermes mine is about 1 km east-southeast of the proposed Ridgetop pit. The Fern mine is about 1 km east-southeast of the proposed Cinnamid pit. The Hermes and Fern mines also are within about 2 km of felsic volcanic rocks of the Eocene Thunder Mountain Cauldron Complex (compare figs. 18, 23 and 25a)

The tremolite-bearing marble, limestone and dolostone layers that host the Hermes and Fern hot-spring mercury deposits are interlayered with quartzite, calc-silicate gneiss and biotite schist and hornfels, all of which strike northwest and dip steeply northeast (fig. 18). The Hermes and Fern deposits are localized along fault-fracture zones that strike northwest, dip steeply (subparallel to layering), and branch upward.

Hermes mine: The Hermes mine, at Cinnabar Camp, is near the head of the west fork of Cinnabar Creek, and east of a ridge that divides it from the Stibnite mining area. The deposit consists of upward-branching veins, with associated disseminations and replacement pods, that follow a shattered zone in limestone above a footwall of quartzite. Livingston (1919, p. 62) described the deposit as follows: “A heavily iron-stained zone outcrops on the hill north of Cinnabar Creek, in the bluish lime...This iron-stained outcrop consists of shattered lime and some bluish quartz and contains disseminated cinnabar all through it. It is 50 to 60 ft wide...and makes a bold and prominent exposure...The cinnabar mineralization is found almost as far down as Cinnabar Creek, and has been opened up by three tunnels...The lowest of the tunnels follows a shattered mineralized zone, which appears to be along a contact between the quartzite and the lime."

At least 354 tonnes of mercury have been produced from the Hermes deposit. Mercury production probably began in about 1917, peaked between 1942 and 1948, and resumed between 1955 and 1959. Total production is difficult to estimate because of overlapping time ranges of available estimates. Nevertheless, it is probable that total production was between 350 and 540 tonnes of mercury, about 170 tonnes of which were produced between 1955 and 1959 (USBM, 1996; Bailey and Smith, 1964; B.F. Leonard, written commun., 1985). In the early 1920s, Mr. Oberbillig, the company president and manager, estimated that average ore grade was 0.5 wt percent Hg (Schrader and Ross, 1926). That grade probably is higher than the overall average for the life of the mine, during which at least 70,000 to 108,000 tonnes of ore were taken from the Hermes mine and processed at Cinnabar Camp. Until the mine closed in 1948, mercury was retorted from mine rock without milling. From 1955 to 1959, the ore was milled and concentrated by gravity separation, and the concentrate was sent to the retort. Tailings from the mill were deposited in a settling pond on Cinnabar Creek. Estimated remaining resources are about 370 tonnes of mercury in 124,000 tonnes of ore, with an average grade of 0.3 wt percent (USBM, 1996).

Fern mine: The Fern mine workings are scattered along the north side of the west fork of Fern Creek. Cinnabar is present in upward-branching veins of chalcedonic silica that cut light yellowish brown, tremolite-bearing dolomitic marble. Cinnabar also is disseminated in iron-stained dolomitic marble near the veins and coats fractures and lines cavities near the veins. The veins strike northwest, parallel to the strike of the dolomitic marble. Livingston (1919) reported production of 4.5 tonnes of ore per day, averaging 5 to 6 wt percent Hg. A small retort at the site was used to recover the mercury. The scattered workings are small and shallow, which indicates that mining was short-lived, and total production was small.

Other prospects and occurrences: The Hennessy mercury-antimony prospect, at the head of Cinnabar Creek (near the Hermes mine), is on a small, carbonate-hosted vein that contains cinnabar and stibnite. The Buck Bed, White Metal, Abstein, and Vermillion mercury prospects are in the Fern Creek drainage, near the Fern mine. They are on small showings of cinnabar-bearing chalcedonic quartz and (or) jasperoidal silica in carbonate rocks. The Mountain Chief mercury-antimony prospect, on a small vein in quartzite, also is in the Fern Creek drainage.

Rationale for Tract Delineation

The permissive tract for hot-spring Hg deposits related to Eocene volcanism includes the Challis Volcanic Field in the PNF (fig. 23) and a 10 km buffer around it. The favorable tract for hot-spring Hg deposits includes Hg mines and prospects of the Cinnabar-camp and Stibnite mining areas (figs. 25a and 25b). These are adjacent to the Challis Volcanic Field, in metasedimentary rocks of a roof pendant in the Idaho Batholith. The favorable tract is the assessment tract. Associated deposit types include Disseminated Sb deposits, and Hg-bearing stage VI mineralization in distal disseminated Au-Ag deposits, and Au-Ag mixed-metal veins.

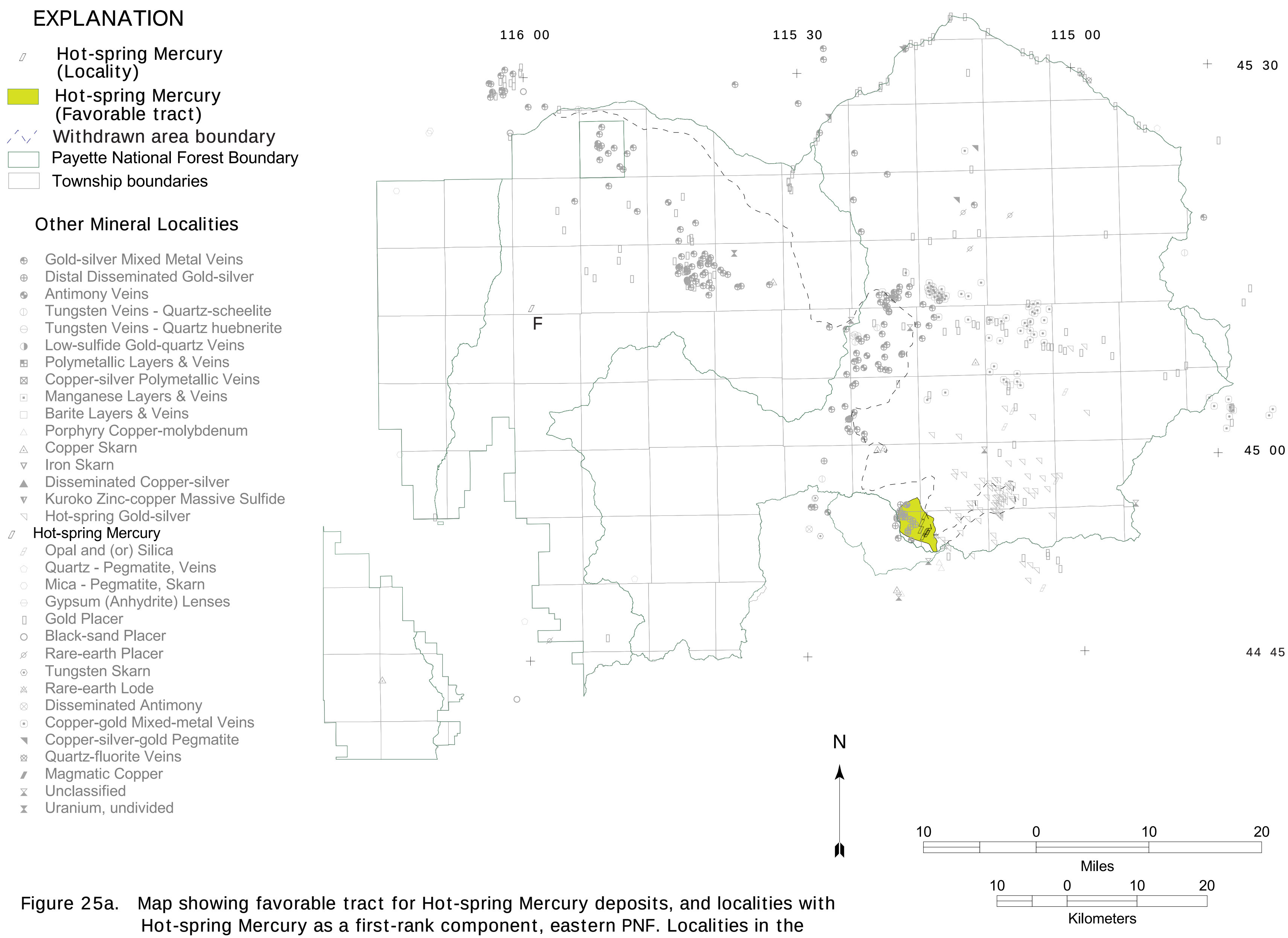


Figure 25a. Map showing favorable tract for Hot-spring Mercury deposits, and localities with Hot-spring Mercury as a first-rank component, eastern PNF. Localities in the favorable tract are related to hot-spring activity associated with the Challis Volcanic Field. Locality labeled F is related to hot-spring activity along faults of possible post-Miocene age.

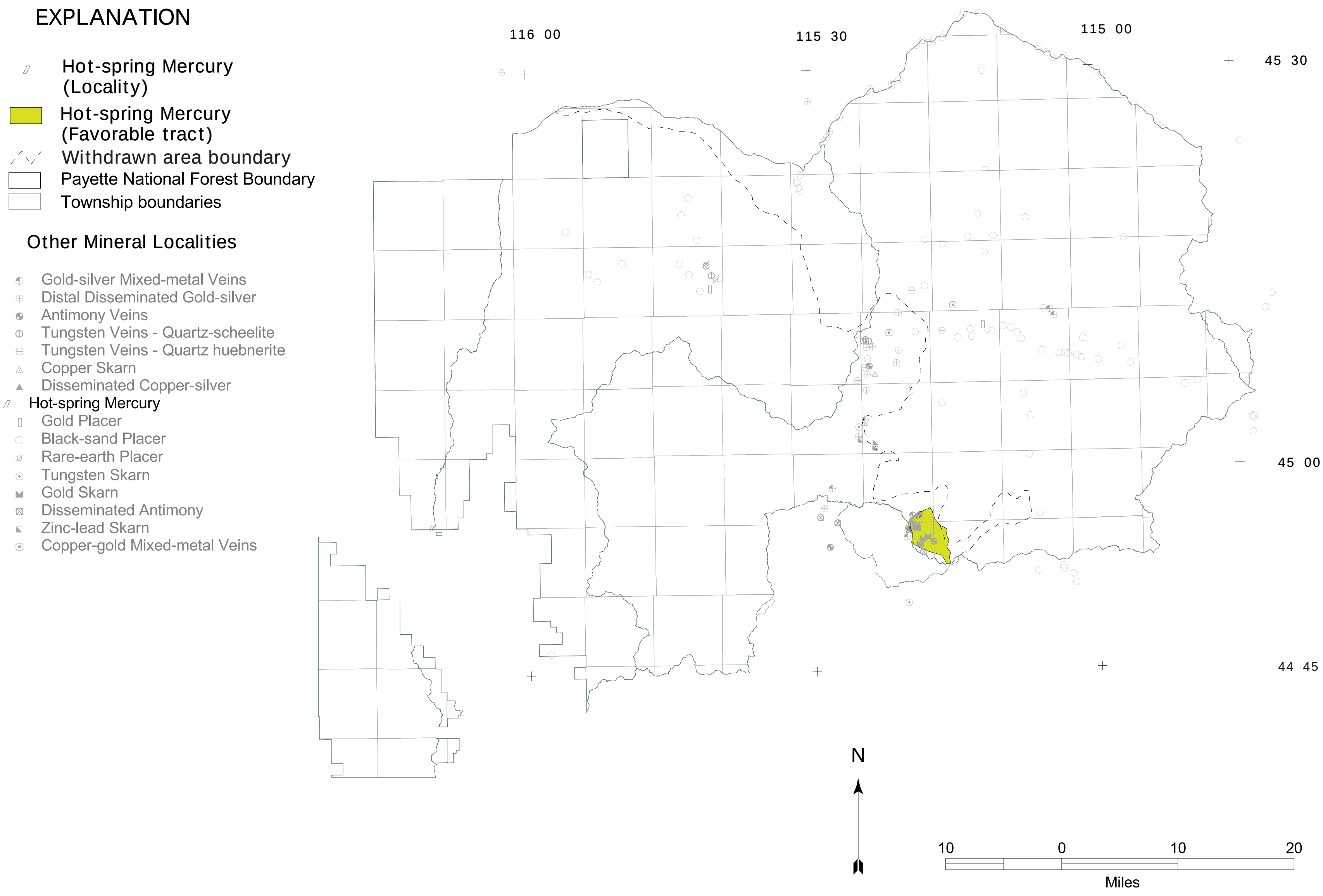


Figure 25b. Map showing favorable tract for Hot-spring Mercury deposits, and localities with Hot-spring Mercury as a second-rank component, eastern PNF.

Table 16. Hot-spring Mercury: Estimate of mineral resources in undiscovered deposits, PNF.

Mark 3 input

Hot-spring Mercury					
Probability	90%	50%	10%	5%	1%
Number of deposits	0	0	2	5	7

Mark 3 output

Estimate of probability of 0 deposits: 60%
Estimate of probability of the median number of deposits (0): 60%
Estimate of mean expected number of deposits: 0.88
Estimates of minimum amounts of metal and ore contained in all undiscovered deposits (in tonnes) at selected probabilities and mean, with the probability for existence of the mean:

Hot-spring Mercury					
Commodity (tonnes)	90%	50% (Median)	10%	Mean	Probability of > or = Mean
Mercury	0	0	1,300	940	12%
ore	0	0	290,000	210,000	13%

Rationale for Numerical Estimation

Estimated production and resources of the Hermes mine fit within the tonnage and grade model for hot-spring mercury deposits by Rytuba (1986b). Numerical estimation of undiscovered deposits was done by target counting and evaluation, and was based on the distribution of known hot-spring mercury localities, and consideration of exploration history. Subjective estimates were made of the number of targets likely to fit between the 10th and 90th percentiles of the tonnage and grade models for hot-spring mercury deposits by Rytuba (1986b). For the 90th, 50th 10th, 5th and 1st percentiles of subjective probability, the team estimated 0, 1, 1, 2, and 3 undiscovered deposits consistent with the tonnage and grade models. Results of the estimation of undiscovered resources in hot-spring mercury deposits are summarized in table 16.

Development Forecast

It is unlikely that there will be significant exploration for or development of hot-spring mercury deposits of the PNF in the foreseeable future. Since World War II "the domestic mercury mining industry has had difficulty competing with foreign producers who have such rich ores and cheap labor that they can undersell U.S. producers" (Bailey and others, 1973, p. 411). Furthermore, since the late 1960s, demand for mercury in the United States has diminished considerably as a result of concern about pollution.
Environmental Effects and Implications

Environmental effects related to mining and processing of mercury deposits can include mercury contamination of soil and water from mine waste rock and calcined ore, mercury vapor released during ore processing, acid mine drainage, and release of toxic metals (Hg, As, and Sb) into drainage basins. Mercury released into lakes or bogs can become methylated, and methylmercury may become concentrated through biomagnification in fish and animals that consume fish (Rytuba and Kleinkopf, 1995).

In 1996, the EPA did an emergency removal action to clean up mercury and other industrial contamination in and around the Hermes mine-mill-retort complex at Cinnabar Camp. An old retort, which contained liquid mercury, was buried in a "burial cell." Flasks of liquid mercury, and soils contaminated with liquid mercury were removed. Also, Cinnabar Creek was diverted around the mill tailings through which it was flowing (J.D. Egnew, USFS, personal communication, 1997).

Water samples taken from Cinnabar Creek by USGS in August 1994 had pH 7.9 to 8.2 and contained < 0.1 to 0.2 ppb Hg, 10 to 49 ppb As, and 6 to 8 ppb Sb. The high pH is attributed to the fact that much of the cinnabar in the Cinnabar Camp area is hosted in carbonate rocks, which buffer the pH of mine-drainage waters.

Opal
deposit code 020

USGS model -- no USGS model

Description -- opaline silica in devitrified felsic tuffaceous rocks

"Opal consists of microspheroids of hydrous silica... Precious opal is porcelaneous and may have various colors, with a characteristic play of colors caused by the dispersion of light that varies according to the angle of incidence and the size of the ordered spherical particles of which the mineral is composed" (Mottana and others, 1978, p. 248).
In the PNF, opal occurs in veins, veinlets, pods, fissures, and vugs in or near felsic tuffaceous volcanic rocks of the Challis Volcanic Field (fig. 26).

Interpretation -- supergene concentration of volcanic-derived silica

Opal deposits of the eastern PNF are interpreted as products of supergene deposition of silica derived from tuffaceous volcanic rocks. As shards of silica-rich volcanic glass are weathered, they devitrify and release silica to the groundwater. Silica in groundwater may then be deposited in fractures to form opal.

Examples

All five of the opal localities listed in Table 2 and appendix B are hosted in fractured felsic volcanic rocks of the Eocene Thunder Mountain Cauldron Complex. Four are in the Big Creek mining district, and one is south of the PNF, near Marble Creek.

Semi-precious opal has been recovered from the Redridge mine. Opal also is present at the Monument, Bear Trap, and Ketchum occurrences, all of which are in the Krassel Ranger District and the Frank Church River of No Return Wilderness Area. Total production from the Redridge mine has been about 270 tonnes of rock from which 91 kg of yellow opal was removed. According to Cater and others (1973, p. 306-308), the opal is present "as irregular masses a maximum of a few inches across and an inch or more thick in northeast-to northwest-trending fractures in rhyolite," which contains about 50 percent of rounded blebs of black obsidian glass in a devitrified matrix. "The opal is transparent, yellow, free of fractures, and of good quality...A small amount is orange to red or contains manganese dendrites." About 91 kg of hand-sorted yellow opal was produced in 1970. The Redridge mine has an indicated reserve of 4.4 tonnes, and an inferred resource of 364 tonnes of yellow opal. "Yellow Gem mine" may be another name for the Redridge mine, which is located on the Redridge claim group (J.D. Egnew, written commun., 1997).

Rationale for Tract Delineation and no Numerical Estimation

The entire Challis Volcanic Field is considered permissive for opal, which can form as a result of weathering of siliceous volcanic rocks. Too little is known about opal deposits in the PNF to delineate favorable tracts, and no tonnage-grade models are available for numerical estimates of resources of undiscovered opal deposits.

Development Forecast and Environmental Implications

Inasmuch as the known opal deposits of the PNF are in the Frank Church - River of No Return Wilderness area, it is unlikely that they will be developed in the foreseeable future. Past small scale mining of opal has resulted in a few small surface disturbances, and has had negligible chemical-environmental impact.

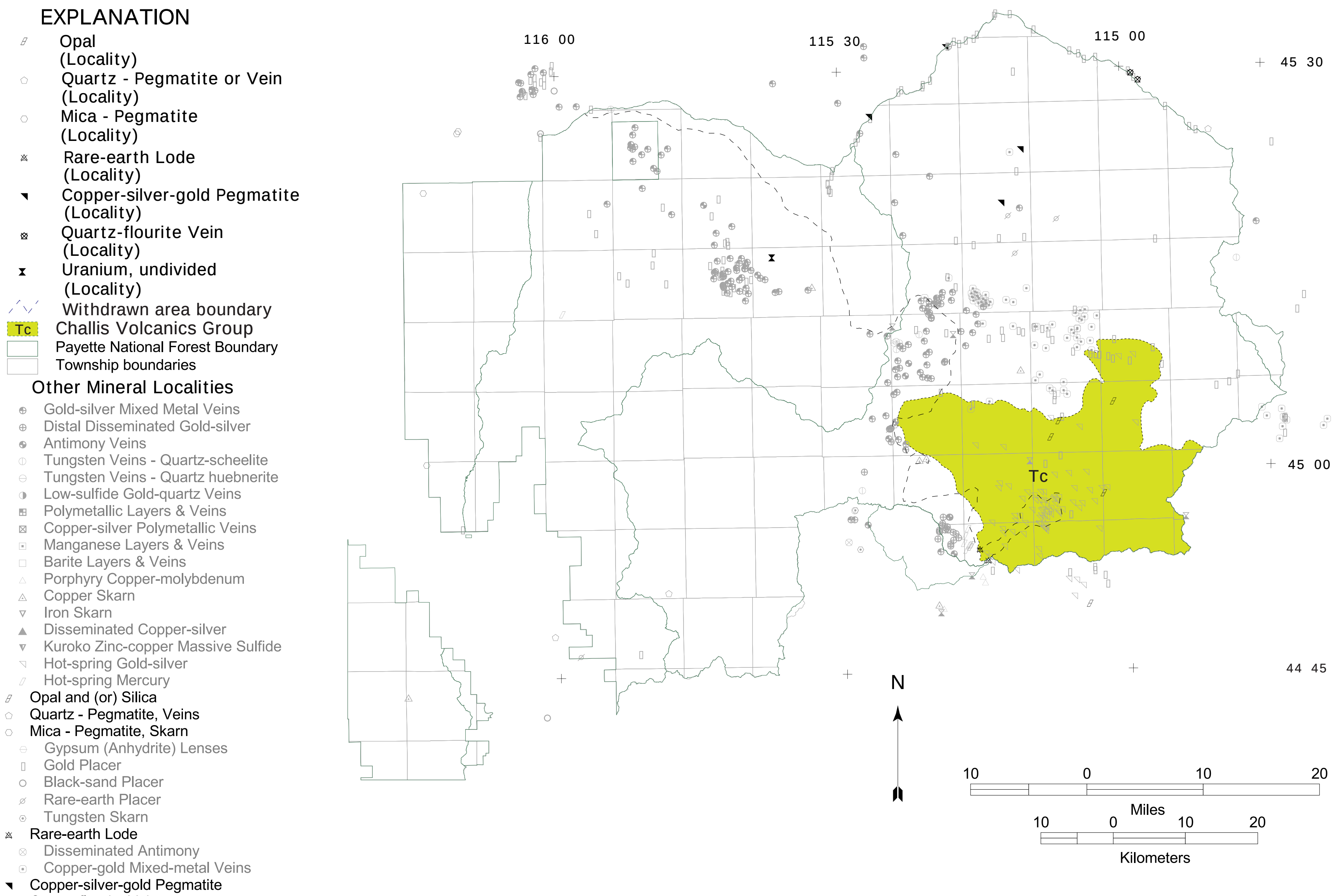


Figure 26. Map showing localities of miscellaneous deposit types: Opal, Quartz -- Pegmatite or Vein, Mica -- Pegmatite, Copper-silver-gold Pegmatite, Quartz-fluorite Vein, Rare-earth Lode, Uranium Lode.

Rare-earth Lodes
deposit code 029

USGS model -- no USGS model

Description of Example -- fault-hosted rhabdophane

Rhabdophane, a hydrated phosphate of the cerium-group rare-earth elements, is present in limonite along faults that are exposed in road cuts on the west side of Monumental Summit (fig. 26). The mineralized and oxidized faults lie within a larger fault zone that separates Miocene volcaniclastic rocks of the Challis Volcanic Field from the Idaho Batholith and its metasedimentary host rocks. Rhabdophane occurs as "yellowish-brown to white aggregates of intergrown spheroidal forms less than 20 microns in diameter," with radial crystalline structure (Adams, 1968, p. B49). It is present in association with goethite and kaolinite, and geochemically anomalous concentrations of arsenic, manganese, mercury and zinc (Adams, 1968).

Interpretation -- supergene concentration of volcanic-derived REE

Supergene concentration of volcanic-derived REE is indicated by the association of limonite with microspheroids of rhabdophane in faults that bound a felsic volcanic field.

Rationale for no Tract Delineation and no Numerical Estimation

Fault zones in and around the Challis Volcanic Field are permissive for rhabdophane occurrences, but no permissive or favorable tracts have been delineated, because too little is known about the geologic controls on rhabdophane distribution. No tonnage-grade model is available for rhabdophane occurrences, so no numerical estimate was made for undiscovered rhabdophane resources.

Development Forecast and Environmental Implications

World demand for rare-earth elements is met by production from a few very large deposits that have very expensive processing facilities nearby. Rhabdophane occurrences of the Monumental Summit area probably could not support an economically viable rare-earth recovery operation. Therefore, no exploration or development activities are foreseen, and no significant environmental impacts are expected, beyond those of the road cuts along which the rare-earth occurrences are exposed.

Mineral Deposits Associated with Eocene Intrusions

Minor copper-silver-gold pegmatites, a few Ag-Au polymetallic veins, and a few quartz-fluorite veins are present within or near the Eocene syenogranite intrusion of Chamberlain Basin, in the eastern PNF.

Copper-silver-gold Pegmatite
deposit code 034

Cater and others (1973) reported that a few pegmatites contain trace to moderately anomalous concentrations of copper, silver, and gold (0.1 to 0.4 wt percent Cu, 1.7 to 9.5 ppm Ag, and trace gold) at the Churchill Creek, Eagle, and Hamilton-Hillsman mineral occurrences. These metal-bearing pegmatites are in the Eocene syenogranite intrusion of Chamberlain Basin (Karen Lund, unpub. data, 1997). The copper-silver-gold pegmatite occurrences are insignificant as mineral resources, and therefore no permissive or favorable tracts were delineated, and no estimates were made for undiscovered resources of this type. No further exploration or development of such deposits is expected in the PNF, since they are of no economic interest, and they lie in the Salmon River Wild and Scenic Area of the eastern PNF (fig. 26).

Ag-Au Polymetallic Veins
deposit code 001

USGS model -- Polymetallic veins (model 22c)

Cox (1986a) wrote USGS descriptive model 22c for polymetallic veins. Bliss and Cox (1986) wrote the accompanying grade and tonnage model.

Description -- Ag-Au polymetallic veins in Eocene syenogranite

Polymetallic veins are quartz-carbonate veins with Au and Ag associated with base metal sulfides related to hypabyssal intrusions in sedimentary and metamorphic terranes (Cox, 1986a). Those of the eastern PNF are within or near the Eocene syenogranite intrusion of Chamberlain Basin, which intrudes a metasedimentary terrane.

Interpretation -- magmatic-hydrothermal veins, related to Eocene syenogranite

Ag-Au polymetallic veins of the eastern PNF are interpreted as magmatic hydrothermal veins, related to the Eocene syenogranite of Chamberlain Basin.

Examples

The Hermit Hanks, Imperial, and Cottonwood Buttes prospects resemble Au-Ag mixed metal veins of the Idaho Batholith, and were assigned a preliminary deposit code dc1=001 for Au-Ag mixed metal veins (appendix B and figure 16a). However, further study has shown that those three veins are within or near the Eocene syenogranite pluton of Chamberlain Basin. Alternative deposit code dc2=050 is therefore preferred for these Ag-Au polymetallic veins, which are related to Tertiary intrusions.

Rationale for Tract Delineation and Reason for no Numerical Estimation

Permissive and favorable tracts were not delineated for Ag-Au polymetallic veins, because they were not recognized as a deposit type different from Au-Ag mixed-metal veins when tracts were delineated by the assessment team. Numerical estimation of undiscovered resources were not done, for the same reason. Furthermore, too little is known about the size and grade of the identified prospects, to tell if they fit the grade and tonnage model for polymetallic veins by Bliss and Cox (1986).

Development Forecast, Environmental Effects and Implications

Ag-Au polymetallic veins of the eastern PNF will not be developed in the foreseeable future, because they are in the Frank Church - River of No Return Wilderness area. Environmental effects of small prospects on these veins probably have only minimal and localized environmental effects.

Quartz-fluorite Veins
deposit code 035

USGS model -- Fluorite veins

Orris (1992c) presented USGS grade and tonnage model 26b for fluorite veins.

Description -- quartz-fluorite veins near Eocene syenogranite

Quartz-fluorite veins are tabular fractures filled with quartz and fluorite. Those of the eastern PNF are hosted in Precambrian gneiss near the northern contact of the large syenogranite pluton of Chamberlain Basin, which is Eocene in age (Karen Lund, unpub. data, 1997).

Interpretation -- quartz-fluorite veins, related to Eocene syenogranite

Quartz-fluorite veins of the eastern PNF are interpreted as magmatic-hydrothermal veins, related to the Eocene syenogranite pluton of Chamberlain Basin.

Examples

The Big Squaw Creek, or Smothers quartz-fluorite vein deposit is in the Salmon River Wild and Scenic Area, north of the river, and outside the PNF (fig. 26). The vein has been traced for 600 m on the surface. One ore shoot averages 2 m thick along 180 m in strike length, and averages 67.5 percent CaF_2 (Weis and others, 1972, p. C 32). A resource of about 102,000 tonnes of metallurgical-grade or near metallurgical-grade fluorspar is inferred from surface outcrops (USBM, 1996, p. A-125).

Quartz-fluorite veins south of the river and inside the PNF contain a few short fluorite-bearing stringers, but in general the veins contain less than 3 percent fluorite (Cater and others, 1973, p. 326). No permissive or favorable tracts were delineated for quartz-fluorite veins, and no numerical estimates were made for undiscovered resources of such veins in PNF. No further exploration or development of quartz-fluorite veins is expected in PNF.

Mineral Deposits Associated with Post-Miocene Faults

Hot-spring Mercury
deposit code 019

USGS model -- Hot-spring Hg (model 27a)

Descriptive model 27a for Hot-spring Hg deposits (Rytuba, 1986a) is accompanied by a grade and tonnage model by Rytuba (1996b).

Description -- Hot-spring Hg along fault and fracture zones

Minor Hot-spring Hg deposits in the northwestern part of the eastern PNF are present in the Resort mining district, where they are hosted in a fracture zone in tonalite of the Idaho Batholith (locality labeled F in fig. 25a).

Interpretation -- Hot-spring Hg related to post-Miocene faulting

Hot-spring Hg deposits of the Resort mining district are interpreted as epithermal deposits related to fault zones that carried Hg-bearing geothermal fluids. Bergdorf hot springs provides an active analogue. It is along a post-Miocene block fault that bounds the half-graben of the Lake Creek structural valley.

Example

Resort district: The Bostic mercury-antimony prospect is in the Resort mining district, near Cloochman Saddle, in the Victor Peak 7.5’ quadrangle. The host rock is foliated hornblende-biotite tonalite of the western margin of the Idaho Batholith. Workings consist of ten trenches and ruins of a mill and retort. USBM samples contained up to 0.014 wt percent mercury and 1.1 wt percent antimony (USBM, 1996, p. A-39).

The Ruby Creek gold placers in the Resort mining district (fig. 27), contained considerable amounts of cinnabar (Capps, 1940). The headwaters of Ruby Creek lie about 4 km southeast of the Bostic prospect, and in a different drainage. This indicates that cinnabar is not confined to the Bostic prospect, but is more widely distributed in the Resort district.

Placers

Placers are deposits of residual and (or) detrital material that contain a valuable mineral or minerals, accumulated through surficial concentration processes, such as weathering, and (or) differential transport and deposition. Prerequisites for a placer are: 1. a valuable mineral that is relatively heavy and resistant to chemical or physical disintegration; 2. release of the valuable mineral from its bedrock source; 3. concentration of the valuable heavy mineral into workable deposits (USBLM, undated). Concentration of the valuable heavy mineral can occur by residual concentration, differential physical transport and deposition, and (or) differential chemical transport and deposition. Moving water is the most effective agent of differential transport involved in concentration of valuable heavy minerals in placers (USBLM, undated). Heavy minerals tend to resist fluvial transport, relative to lighter minerals. Therefore, fluvial placers tend to form where water velocity lessens, for example where stream gradients lessen, where valleys widen, and (or) where streams enter ponds or lakes. On a smaller scale, fluvial placers tend to form in eddies behind obstructions, or in point bars along the inside margins of stream meanders.

Gold and (or) electrum, cinnabar, and scheelite are very heavy minerals that tend to concentrate in placers, in and around mineralized areas. Other heavy minerals that tend to collect in placers are black-sand minerals such as magnetite, ilmenite, sphene, brannerite, uranothorite, and $(Nb,Ta)_2O_5$ minerals; rare-earth-bearing minerals, such as monazite and allanite; and semi-precious to precious gem minerals, such as garnet, corundum (sapphire), tourmaline, topaz, zircon, and diamond (Savage, 1961).

Gold Placers
deposit code 024

USGS model -- Placer Au-PGE (model 39a)

Yeend (1986) wrote a USGS descriptive model for placer Au-PGE deposits. Orris and Bliss (1986) wrote the accompanying grade and tonnage model. Orris and Bliss (1985) presented grade-volume data on 330 gold placer deposits.

Description -- gold in unconsolidated surficial sediments

Gold placers contain flakes, grains, and nuggets of elemental gold and (or) electrum. These are disseminated in relatively unconsolidated surficial sediments that generally consist of gravel, sand, silt, and clay (Yeend, 1986).

Interpretation -- gold, freed by weathering, concentrated by differential transport and deposition

Gold placers form by weathering and release of gold from parent rocks (gold lodes), followed by concentration of gold by differential erosion, transport, and deposition, relative to other mineral grains with lower densities. The ratio of the specific gravity of gold (19) to that of gravel (2.65) is 7/1 in air, and 11/1 in water (USBLM, undated). Thus, washing gravel with water tends to separate gold from gravel by residual concentration, and (or) by preferential settling. Gold tends to be deposited where alluvial gradients flatten and water velocities lessen (Yeend, 1986). Gold also is somewhat soluble in humic acids, and some placer gold nuggets show textural evidence of growth by chemical accretion.

Residual placers are concentrations of heavy minerals at or near their point of release from their parent rock. Residual enrichment results from elimination of valueless minerals. *Eluvial (or colluvial) placers* are irregular sheets of surface detritus and soil that can form on slopes down-hill from residual placers.

Alluvial (or stream) placers form in gulches, creeks, rivers, floodplains, braidplains, meadows, and (or) lake deltas. *Flood placers* form at high-water stages, and are left behind as the water recedes. *Bench placers* are remnants of deposits formed during earlier stages of stream development, and left behind as the stream down-cuts (USBLM, undated). Glacial moraines generally are not well-enough sorted to form placer concentrations, but glacial meltwaters act on glacial moraines to produce glacial outwash deposits that commonly contain *glacio-fluvial placers.*

Examples

Table 2 and appendix B list gold placers as first-rank components at 131 localities, and as second-rank components at two localities in the PNF and vicinity. Locations of gold placers and placered stream valleys in the PNF are shown in figure 27. Production and resources of notable gold-placers in the PNF are summarized in table 17.

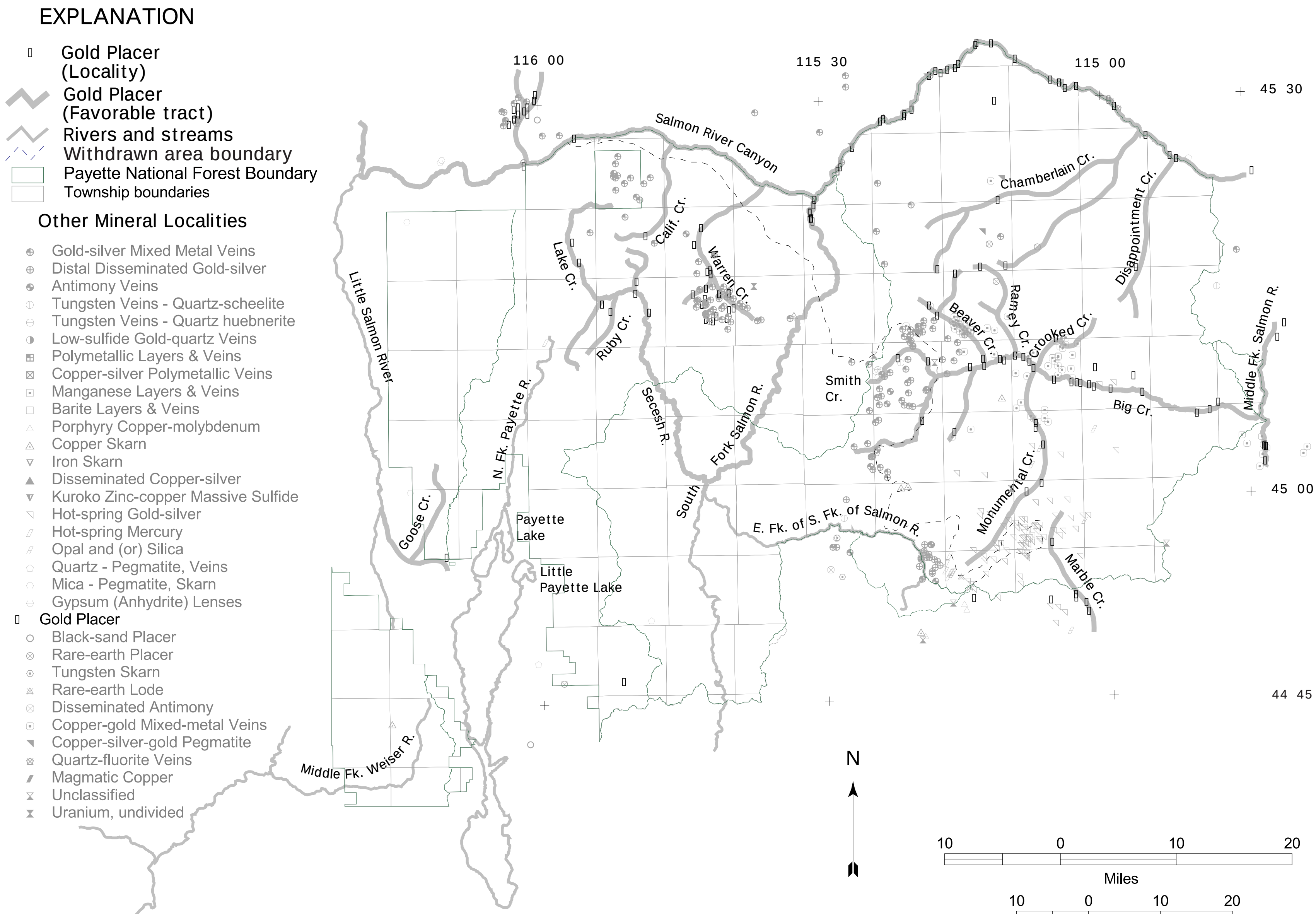


Figure 27. Map showing localities and favorable tracts for Gold Placers, eastern PNF.

Table 17. Selected gold placers of PNF: Production and resources

Map no.	Placer Area	Placer Name	Production (kg gold)	cubic meters	grade (g/cu m)	Resources (kg gold)	cubic meters	grade (g/cu m)	gold $/cu m @ $10/g Au	black sand kg/cu m
628	**Warren** [1]	Warren Meadows, Warren Creek, Steamboat Creek	24,400	205,000,000	0.119				1.19	
544	**Smith Creek** [2]	Smith Creek (upper)	104		0.03 - 4.07					
544		Smith Creek (upper)	0.3	11,500	0.0285					
543		Smith Cr. - Big Cr. (lower-upper)				236	10,700,000	0.0221	0.22	0.1 - 3.1
543		Smith Cr.- Big Cr. (above junction)				217	1,510,000	0.144	1.44	0.3 -5.2
543		Smith Cr - Big Cr. (below junction)				418	756,000	0.547	5.47	1.0 - 4.1
322	**Big Creek** [2]	John Vine Bar				33.1	3,100,000	0.0107	0.11	4.2
403		Mile Flat				0.581	109,000	0.00533	0.05	5.7
		Cougar Creek				0.0312	22,900	0.00575	0.06	7.3
521	**South Fork S.R.** [2]	Salmon Placer North	0.774	1,350	0.573				5.73	
521		Salmon Placer North				4.5	612,000	0.00735	0.07	0.59
299		Huddleston				40	688,000	0.0581	0.58	0.54
425		Mountain Sheep				13	789,000	0.0166	0.02	0.7
31	**Salmon River** [2]	Barth Hot Springs				33.4	2,060,000	0.162	1.62	
279		Hermit Hanks Bar				6.61	145,000	0.0456	0.46	
	Salmon River [3]	at Warren Creek				29.7	173,000	0.165	1.65	
		at Indian Creek				3.39	12,500	0.271	2.71	
		at Bull Creek				6.57	20,200	0.325	3.25	
		at Elk Creek				0.541	1,840	0.294	2.94	
		Total	25,505	205,012,850		1,042	20,711,940			

1. Reed (1937, 2. Cater and others (1973), 3. Ridenour (1985)

Representative sampling and estimation of placer gold resources is very approximate and uncertain, because of: (1) logistical difficulties in obtaining samples to represent the entire range of vertical and lateral variability of the deposits; (2) the large range of particle sizes in many placers, (3) the high unit value of gold, and (4) the erratic distribution of gold in placer deposits (USBLM, undated). Cater and others (1973) reported results of their sampling of many of the gold placers of the PNF in terms of site location, size (acres), estimated volume (cu yd), sample depth interval, colors (number and size of gold grains recovered), and value (in cents per cu yd, based on a gold price of $47.85 per troy ounce).

The gold-resource estimates in table 17 were calculated from the data of Cater and others (1973), as follows. The gold value for each sample was multiplied by its depth interval, and the total of the products was divided by the total of the depth intervals to yield an interval-weighted average gold value for the placer. The weighted average gold value (in cents per cu yd at $47.85 per troy ounce) was converted to gold grade in g/cu m, the tonnage was converted to metric tonnes, and the gold content was calculated in kg. An estimate of current dollar value per cu m was then calculated, using a gold price of $10 per gram ($311 per troy ounce).

Dewey mine area: Placer gold deposits of the Dewey mine area probably were residual and (or) elluvial placers, formed by weathering and residual concentration of gold in soils, with little erosion and transport from the site of the source bedrock-hosted hot-spring gold-silver deposits. Delicate gold needles are reported to have been found in organic-rich mud in wetlands of the Mule Creek drainage, not far downstream from the Dewey mine (T.H.Kiilsgaard, USGS, personal communication, 1994). Such delicate forms suggest chemical transport and deposition of gold to form needle-like skeletal gold crystals, which probably could not have survived mechanical transport without being deformed.

Warren district: Gold in the significant placer gold deposits of the Warren district was derived from gold-silver mixed-metal veins of the Warren mining district. Capps (1941) identified gold placers in the following environments in the Warren district: (1) fluvial gravel deposited in the wide, relatively flat, fault-controlled valley of Warren Meadows; (2) old gravel of uncertain age (with highly weathered particles); (3) Early Pleistocene moraines (with highly weathered boulders); (4) Interglacial outwash (with moderately weathered particles); (5) Late Pleistocene moraines; (6) high-meadow gravel, and (7) gravel of present stream channels.

Upstream from Warren Meadows, narrow bench and alluvial placers along Warren and Steamboat creeks "were exceedingly rich, and have contributed much to the district's [early] placer production" (Reed, 1937, p. 30). Small alluvial placers also were mined along tributaries to upper Warren Creek, such as Slaughter Creek and Smith Creek, and along tributaries to Warren Meadows, such as Sratton and Thomas creeks (Lorain and Metzger, 1938).

The Warren Meadows gold placers were larger but lower-grade than those of its narrow tributary valleys. In 1937, Capps observed that dredging had uncovered Tertiary sedimentary beds below bench gravel, and noted that the Tertiary beds dip west, toward the normal fault that bounds the Warren Meadows half-graben on the west. North of Warren Meadows, gold placers were mined in Schissler and Houston creeks. Another gold placer is present at the confluence of Warren Creek with the Salmon River (see Salmon River placers).

Gold placers of the Warren mining district probably produced approximately 24.4 tonnes of gold and 20.7 tonnes of silver, based on records of annual production in dollars, historical prices for precious metals, assuming that the gold-silver ratio of placer production was the same as the gold-silver ratio of district production from 1919 to 1928, as reported by Reed (1937). Much of that production occurred during an early boom from 1862 to 1870, which was followed by a long period of intermittent lesser production (1870 to 1931), largely from reworking previously-mined placers. Then, from 1931 to 1938, as gold prices increased from $20.67 to $35.00 per ounce, a large bucket-line dredge was used at Warren Meadows, to rework previous wastes, and to mine deeper gravel. Much of the gold recovered by the dredge was in the form of easily-recoverable shot-sized nuggets (Reed, 1937).

Two small placer properties in the Warren area produced minor amounts of gold in the 1980s -- one at the confluence of Webfoot and Martinez creeks, and one at the confluence of Warren and Franklin creeks (Buehler and others, 1993). Maps of placer workings and placer sample locations in the Warren and Secesh areas were presented by Buehler and others (1993). They concluded that the largest placer deposits in those areas have been mined, but that smaller occurrences remain that may be suitable for small-yardage operators and recreational placer miners.

Marshall Lake and Resort districts: Many gold-bearing glacio-fluvial, alluvial, and bench placers are present along streams that drain the Marshall Lake and Resort mining districts (Lorain and Metzger, 1938; Savage, 1961). Examples are present along California Creek, which drains north to the Salmon River, and along Lake Creek and its tributaries, Ruby Creek, Secesh Creek, Grouse Creek, and the Secesh River valley, which drain southeast to the South Fork of the Salmon River, which drains northward to the Salmon River.

Capps (1941) interpreted the Lake Creek, Grouse Creek, Secesh Creek, and Secesh River valleys as fault-controlled valleys, bounded by post-Miocene normal faults. The Burgdorf hot springs rise along one of the normal faults that bounds the Lake Creek valley. The valleys of Grouse Creek and Secesh Creek follow north-northwest striking faults that are up to the west, down to the east. The Secesh Meadows placers are localized in a half-graben, which contains Tertiary sediments that dip about 25^{o} southwest. The Tertiary sediments and are bounded on the southwest by a northwest-striking normal fault, with granitic rocks in its up-thrown southwest block. That fault parallels the Lake Creek - Secesh River fault, which Capps (1941) interpreted as a normal fault, with its southwest block up-thrown relative to its northeast block.

Capps (1941) described placers in the following environments in the Secesh Basin: (1) fluvial gravel in the fault-controlled valleys, (2) Early Pleistocene glacial moraine (with highly weathered boulders), (3) Early Pleistocene glacial outwash (with highly weathered boulders), (4) Interglacial outwash (with moderately weathered boulders), (5) Late Pleistocene moraine, (6) present stream gravel.

South Fork, Salmon River: Evidence of past placer mining is present on most terraces of the lower South Fork, but the only extensive placer mining was done on the southeast side of the mouth of the South Fork of the Salmon River (USBM, 1996). There, a dragline and washing plant were operated on a 24 m high section of gravel. Production in 1937, the last year of operation, was reported as the dollar equivalent of 0.774 kg of gold, recovered from 1,350 cu m of material (Cater and others, 1973). These placers and six others, sampled by Cater and others (1973) are in a corridor of private land, along the lower South Fork, which is surrounded by the Frank Church - River of No

Return Wilderness Area. Gold resources of the placers sampled by Cater and others (1973) are relatively small and low-grade, as indicated by representative examples listed in table 17.

Edwardsburg district: About 104 kg of gold has been recovered from the placers of Smith Creek (table 17), a tributary to Big Creek that heads in the Edwardsburg mining district. Minor gold (0.3 kg) was recovered from Smith Creek above Placer Creek, where low-grade placers consist of poorly-sorted material that has not been upgraded by much fluvial reworking. Cater and others (1973) sampled and estimated the remaining resources of the Smith Creek placer area. In general, average gold concentrations increase downstream, from 0.022 g/cu m near Placer Creek to 0.547 g/cu m in Big Creek below the confluence. Placers above and below the confluence are alternatively named as the Smith Creek Hydraulic Co. placer mines (in this report), or placers of Smith Creek-Big Creek (in USBM, 1996). Placers upstream from the confluence contain an estimated 217 kg of gold in 1.51 million cu m of material with an average grade of 0.144 g Au/cu m (worth $1.44/cu m at $10/g for gold). Placers downstream from the confluence contain an estimated 418 kg of gold in 756,000 cu m of material with an average grade of 0.547 g Au/cu cm (worth $5.47/cu m at $10/g for gold).

Big Creek district: Cater and others (1973) sampled gold placers of 13 alluvial bars and terraces, along a 24 km stretch of Big Creek, from Mile Flat (about 3 km downstream from the confluence of Monumental Creek with Big Creek) to Goat Creek (about 6 km upstream from the confluence of Big Creek with the Middle Fork of the Salmon River). These gold placers are in the Frank Church River of No Return Wilderness Area, and in the Big Creek mining district. They are downstream from gold-silver mixed-metal veins of the Edwardsburg mining district, copper-gold mixed-metal veins of the Ramey Ridge mining district, and hot-spring gold-silver deposits of the Thunder Mountain mining district. Several small placer gold localities also are present in tributaries to Big Creek, such as Monumental Creek, which drains the Thunder Mountain district, and Beaver and Ramey Creeks, which drain the Ramey Ridge mining district. Gold resources of the large John Vine Bar placer, the medium-sized Mile Flat placer (upstream), and the small Cougar Creek placer, are given in table 17 to represent the range of deposits sampled along Big Creek.

Salmon River canyon: Gold placers of the Salmon River canyon are within the Salmon River Wild and Scenic Area. Cater and others (1973) reported results of sampling of 16 gold placers along the Salmon River between its junctions with its Middle and South forks. The gold placers at Barth Hot Springs Bar are the largest of these, and those at Hermit Hanks Bar (table 17) are typical of others in that reach of the river. Ridenour (1985) evaluated gold placers of fourteen active bars and one terrace gravel along the Salmon River, from Haney Bar (south of the Dixie mining district) to Warren Creek (north of the Warren mining district) and Bear Creek (north of the Marshall Lake mining district). Estimated gold grades of placers down-river from tributaries that drain the Dixie, Warren, Marshall Lake and Florence mining districts are higher than those of placers up-river from them.

Rationale for Tract Delineation

All streams of the PNF are considered permissive for placer gold, which can be derived from many types of gold-bearing deposits. Favorable tracts are limited to reaches of streams and rivers with known gold placers are considered favorable for placer gold deposits, and are shown as wide gray lines in figure 27.

Reason for no Numerical Estimation

A grade-and-tonnage model for placer Au deposits is available, and it includes data from several gold placers in Idaho (Orris and Bliss, 1986). However, numerical estimation was not done for undiscovered placer gold resources, because the area has been very well explored, and we do not expect that significantly large deposits remain undiscovered.

Development Forecast

Placers with gold concentrations of more than about $1.30 / cu m probably will continue to draw interest of small placer miners with loaders and washing plants and (or) recreational placer miners with suction dredges, sluices, and gold pans. Areas of probable future interest are: (1) the Smith Creek - Big Creek placers, which are relatively high-grade (estimated as $1.44 to $5.73/cu m at a gold price of $10/g); (2) scattered remnants of alluvial and bench placers in the Warren and Secesh areas; (3) bars and benches along the Salmon River, south of the Dixie mining district, and (or) north of the Warren and Marshall Lake mining districts (if gold panning, suction dredging, or other types of placer mining are allowed in the Salmon River Wild and Scenic Area).

Environmental Effects and Implications

Placer mining has disturbed and redistributed alluvium in riparian zones of many drainages of the Warren - Secesh area. For example, the narrow bottom of Steamboat Creek is lined with piles of cobbles and loose sediment, and Warren Meadows is a field of dredge-waste cobble piles, interspersed with semi-disconnected streams and ponds.

Environmental effects of small-scale suction dredging have not been well studied, but disturbance of sediments on the banks and bottoms of streams, and the resulting increase in suspended sediment loads, can be harmful to fish and fish eggs, especially during spawning season. Degradation of fish habitat can also result from removal or rearrangement of boulders and logs, damage to the riparian zone that protects stream banks, and increased sedimentation downstream from placer operations, which can fill holes and flatten bottom profiles.

If mercury has been used to recover gold by amalgamation, mercury liquid and (or) vapor can be released into the environment. Methylmercury can form in marshy or lacustrine environments, and methylmercury may bio-accumulate in fish and in animals that eat fish (Rytuba and Kleinkopf, 1995).

Mercury probably was used by early placer miners in the PNF, and the wreckage of the dredge at Warren Meadows appears to have had copper-plated ramps that would have been coated with mercury to amalgamate fine-grained gold. However, according to Reed (1937) much of the placer gold of the Warren district was in the form of shot-sized nuggets, which did not require mercury amalgamation for their recovery. A water sample, taken from a dredge pond at Warren Meadows on Sept. 18, 1994 had pH = 6.54, and less than 0.1 ppm mercury.

Black-sand and Rare-earth Placers
deposit codes 025 and 026

USGS models -- no USGS models

Description and Examples

Black-sand placers: Black-sand placers of PNF contain heavy metallic-oxide minerals, such as magnetite, ilmenite and rutile; heavy silicate minerals, such as garnet, pyroxene, amphibole, sphene, zircon, tourmaline; heavy radioactive minerals, such as thorite, uranothorite; and a host of niobium-tantalum oxide minerals that may contain uranium, thorium and rare-earth elements. These minerals presumably were derived mostly from igneous rocks of the Idaho Batholith, and (or) from metamorphosed and (or) hydrothermally mineralized rocks within or around the batholith. Table 2 and appendix B list only localities where black sand is a first-rank component, as compared to 100 localities with black-sand as a second-rank component, mostly in gold placers. Locations of black-sand placers as first- and second-rank components of placer deposits in the PNF and vicinity are shown in figures 28a and 28b.

Rare-earth placers: Rare-earth placers contain rare-earth elements (REE) in minerals such as REE-bearing phosphates, like monazite and xenotime; REE-bearing silicates, like allanite; and (or) REE-bearing niobium-tantalum oxides. Table 2 and appendix B list five placers with REE-bearing minerals as a first-rank component, three with REE-bearing minerals as a second-rank component, and 24 with REE-bearing minerals as a third-rank component. The second- and third-rank rare-earth placers are associated with gold and (or) black-sand placers. Locations of placers with REE-bearing minerals as first-, second-, and third-rank components in the PNF and vicinity are shown in figures 29a, 29b, and 29c.

The largest REE and radioactive black-sand placer in PNF is the Paddy Flat placer, which lies east of Long Valley, at the confluence of Paddy, Camp, and Rapid Creeks, in T 17 N, R 4 E. There, Quaternary alluvium overlies an erosional remnant of Tertiary sedimentary strata, surrounded by foliated granodiorite of the Idaho Batholith (Lund, unpub. data, 1997). The Paddy Flat placer consists of 29.4 million cu m of alluvium that contains 7.06 kg ilmenite per cu m, 1.78 kg garnet per cu m, and 0.24 kg monazite per cu m (converted from Kiilsgaard and Hall, 1995, p. 184). The monazite contains 4.2 wt percent ThO_2 and 0.18 wt percent U_3O_8. Several other rare-earth and radioactive black-sand placers are present along the east margin of Long Valley, south of PNF. These include the placers of Big Creek, Pearsol Corral Creek, Upper Clear Creek, Lower Clear Creek, Hull's Big Creek, Scott Valley, Horsethief Basin, and Little Valley (Kiilsgaard and Hall, 1995). Other meadows in PNF may have potential for similar placers.

Rationale for Tract Delineation

All rivers and streams of the eastern PNF are considered permissive for black-sand and REE placers, the valuable minerals of which probably are derived from the Idaho Batholith, and (or) Eocene intrusions of the eastern PNF. Favorable tracts for black-sand placers are limited to reaches of rivers and streams with known black-sand placer deposits are considered favorable for black-sand placers, (as indicated by wide gray lines in figs. 28a, and 28b). Favorable tracts for REE placers are limited to reaches of rivers and streams with known REE placers (as indicated by wide gray lines on figures 29a, 29b, and 29c).

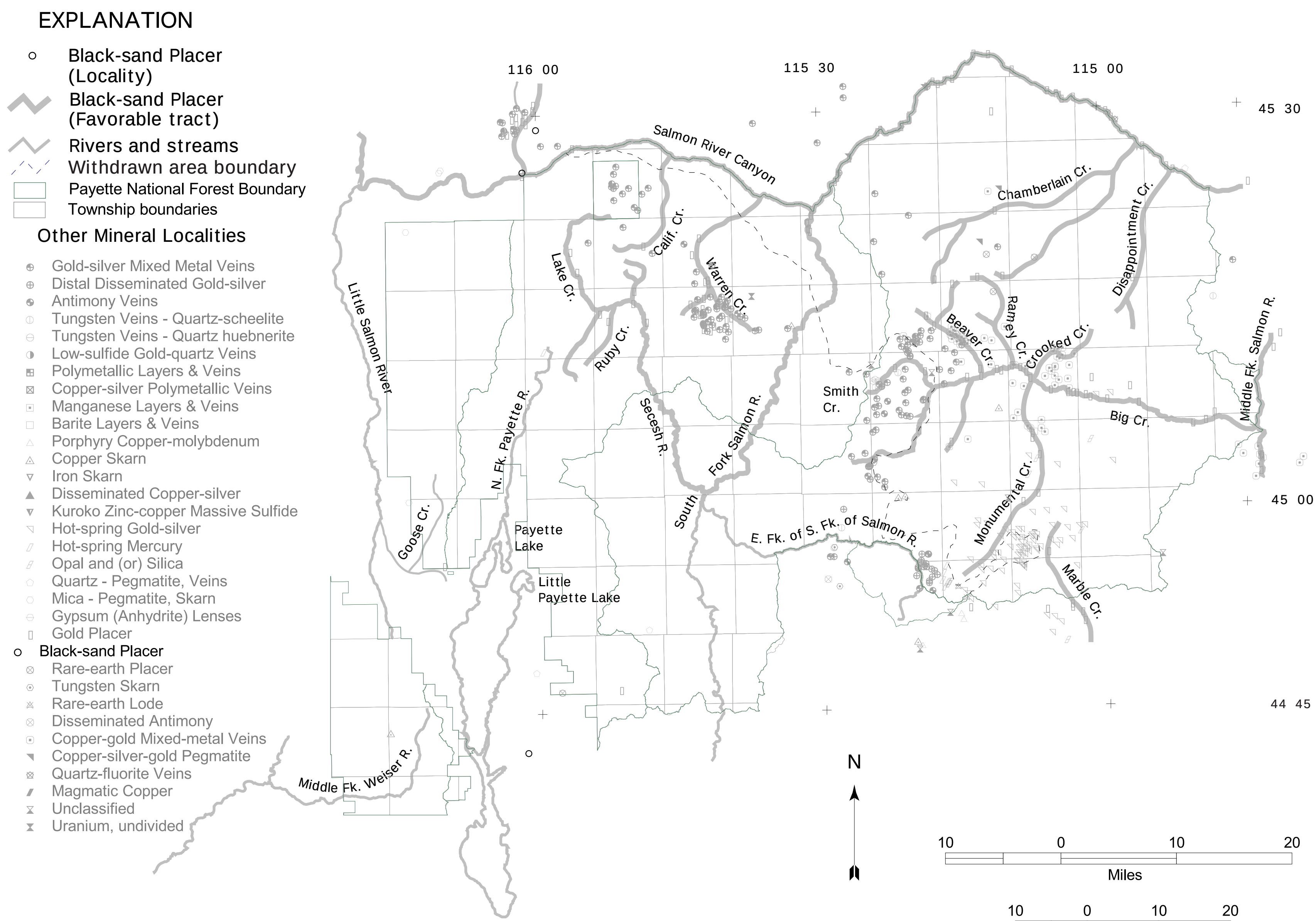


Figure 28a. Map showing favorable tracts for Black-sand Placers, and localities with placer black sand as a first-rank component, eastern PNF.

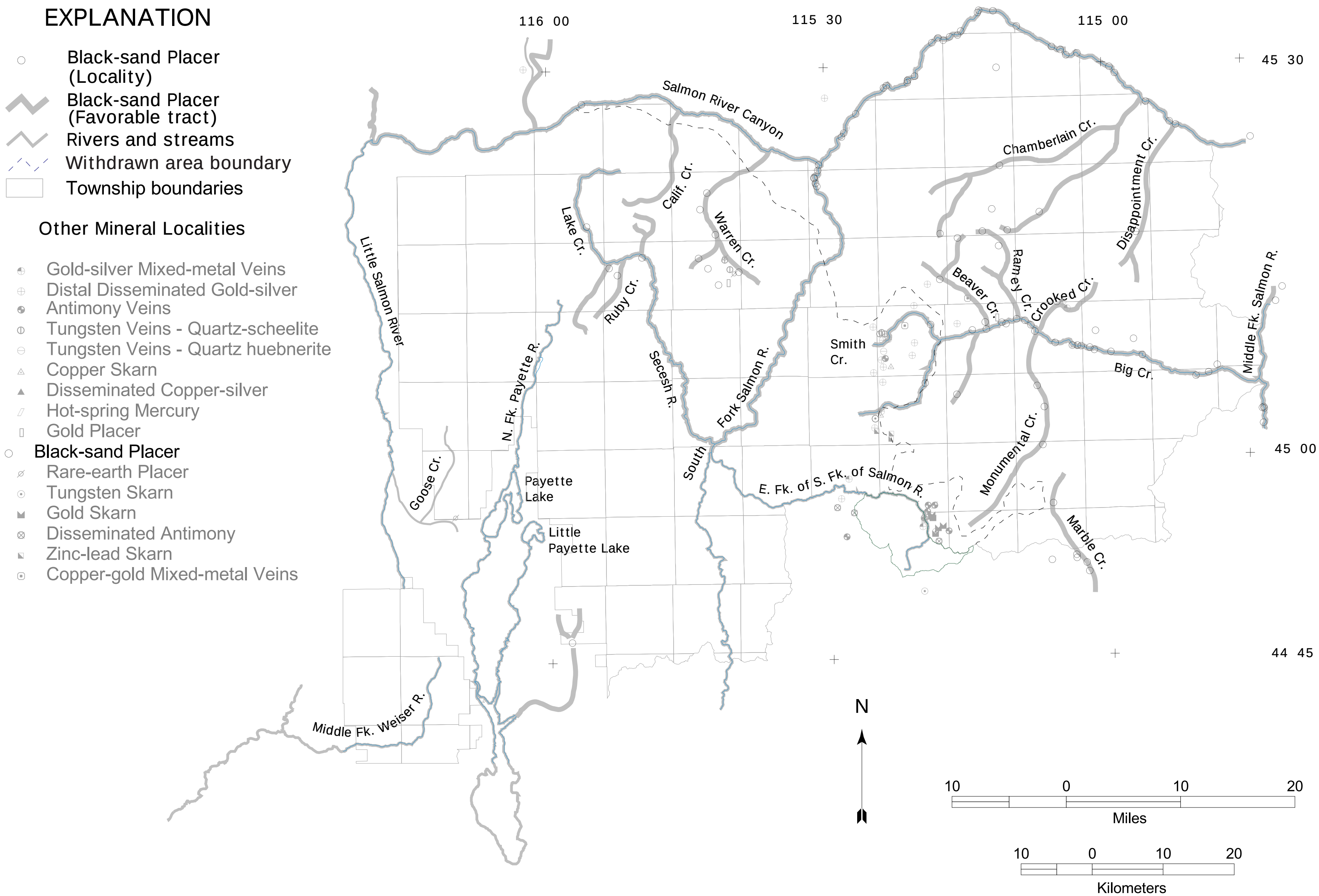


Figure 28b. Map showing favorable tracts for Black-sand Placers, and localities with placer black sand as a second-rank component, eastern PNF.

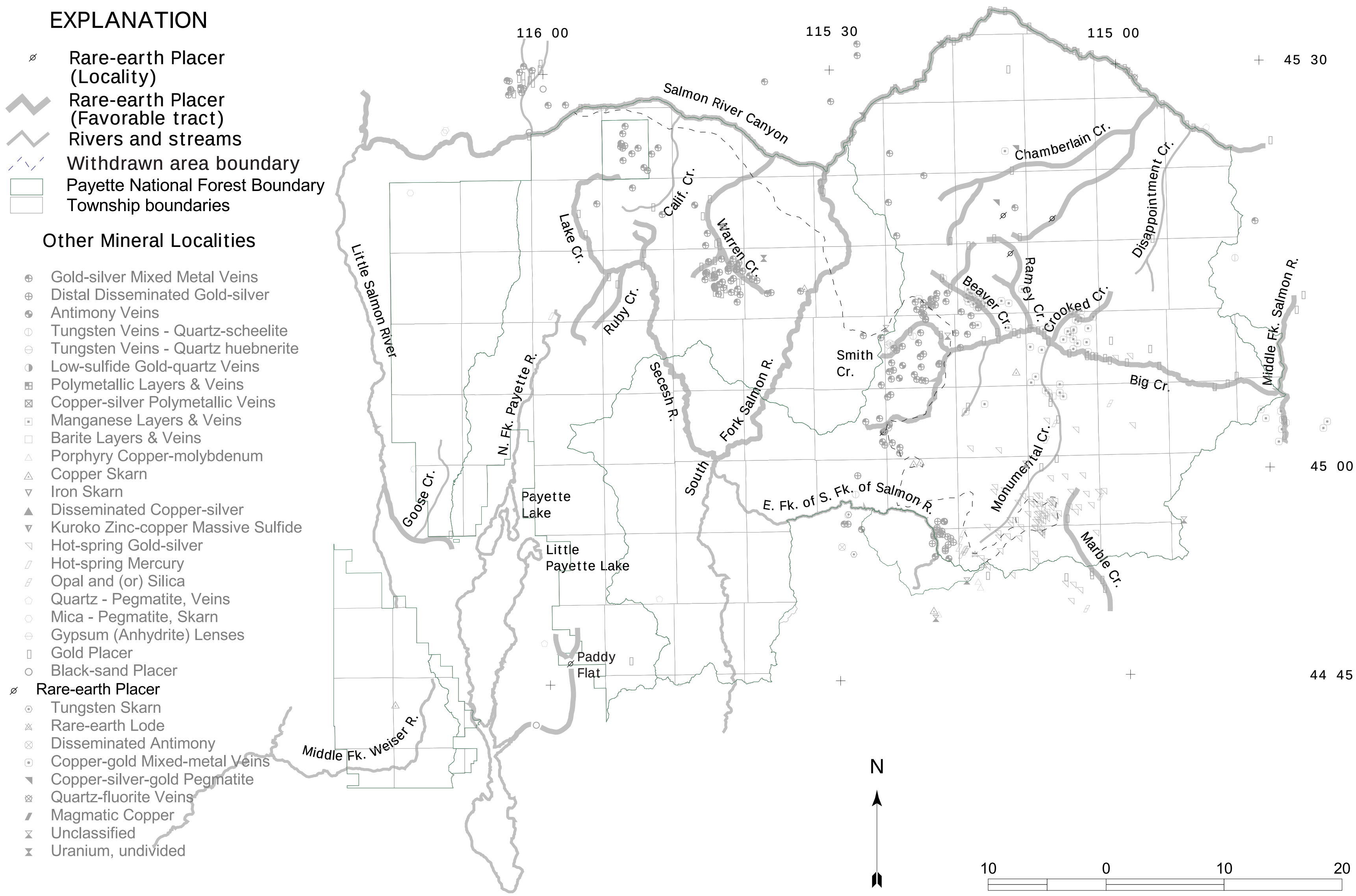


Figure 29a. Map showing favorable tracts for Rare-earth Placers, and placers with rare-earth minerals as a first-rank component, PNF.

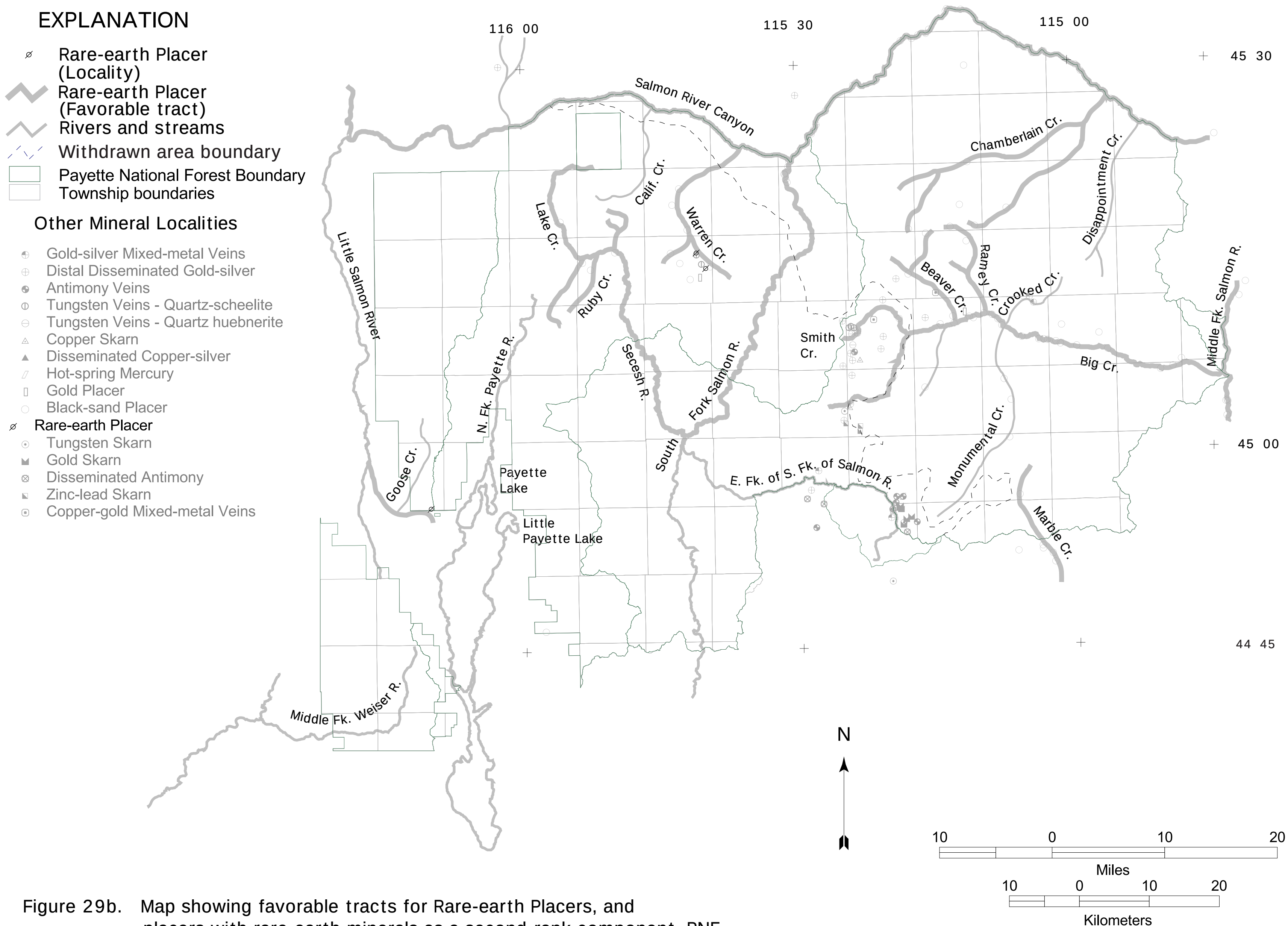


Figure 29b. Map showing favorable tracts for Rare-earth Placers, and placers with rare-earth minerals as a second-rank component, PNF.

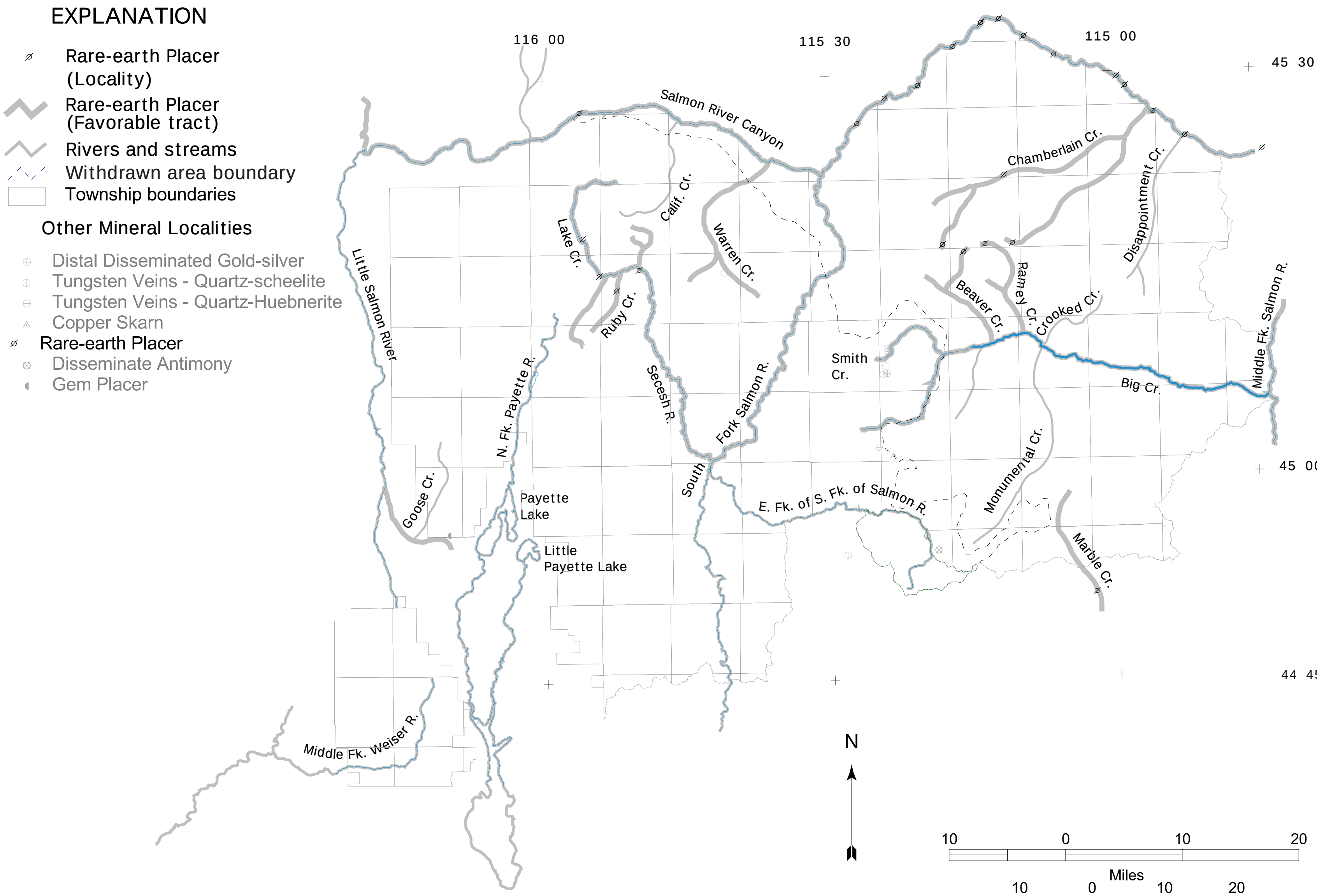


Figure 29c. Map showing favorable tracts for Rare-earth Placers, and placers with rare-earth minerals as a third-rank component, PNF.

Development Forecast

Black-sand placers, REE placers, and (or) REE-bearing black-sands in worked-out gold placers were considered to have economic potential during the 1940s, when government stocks of monazite were depleted because of export restrictions by India and Brazil (Ridenour, 1985). During the 1950s and early 60s black-sand placers also were considered as possible sources of niobium, tantalum, yttrium, zirconium, hafnium, uranium, thorium, and titanium (Savage, 1961). A black-sand dredge operated near Cascade from 1950 to 1955, where it recovered monazite, ilmenite, zircon and garnet. It was forced to suspend production in mid-1955, when the government monazite stockpile was refilled, and new contracts were unobtainable (Ridenour, 1985). Except for minor clean-up operations, it has not resumed production.

Assuming the continuance of relatively free world trade in titanium, niobium, tantalum, yttrium, zirconium, hafnium, uranium, thorium, and rare-earth elements, lower-cost sources with associated recovery facilities can supply the world market for these elements. It is therefore unlikely that black-sand and (or) REE placers of PNF and vicinity will be actively explored or developed in the foreseeable future, but their resource potential should not be overlooked and forgotten (T.H. Kiilsgaard, written commun., 1997).

Environmental Impact

Placer operations cause surface disturbances, which commonly are along rivers, streams, and riparian zones. Aquatic and riparian habitats are changed by placer excavations, and suspended sediment lodes of placered streams are likely to increase dramatically during active placer operations. Since black-sand and rare-earth placers are unlikely to be developed, however, they are not expected to have any significant environmental impacts.

Gem Placer

deposit code 047

The Rock Flat placer area is along the south fork of Little Goose Creek, about 3 km northwest of McCall, and 10 km southeast of New Meadows (fig. 30). Heavy-mineral concentrates from the Rock Flat placer contain abundant ilmenite, magnetite, zircon; minor monazite, and traces of gold, chromite, corundum, chromian garnet, and diamond (See diamonds, this report). Four diamonds, reportedly recovered from the Rock Flat placers, were described by Shannon (1926) and Hausel (1995).

Williams (1964) reported that a few gem-quality sapphires and rubies have been found in placers near New Meadows. The corundum-bearing alluvium overlies highly deformed and metamorphosed rocks of the suture zone between continental and accreted terranes. Recreational miners also dig and screen for corundum of various colors in alluvium of the Rock Flat placer area. Corundum also is reported in placers of the Resort mining district (appendix B).

Streams that drain the area of the suture zone (figs. 4 and 5) are considered permissive for gem placers, since the gems probably are derived from rocks of the suture zone. Known gem placer prospects are present in the New Meadows and Rock Flat areas, and in the Resort mining district. Reaches of streams in those areas are considered favorable for gem placers, as shown in figure 30.

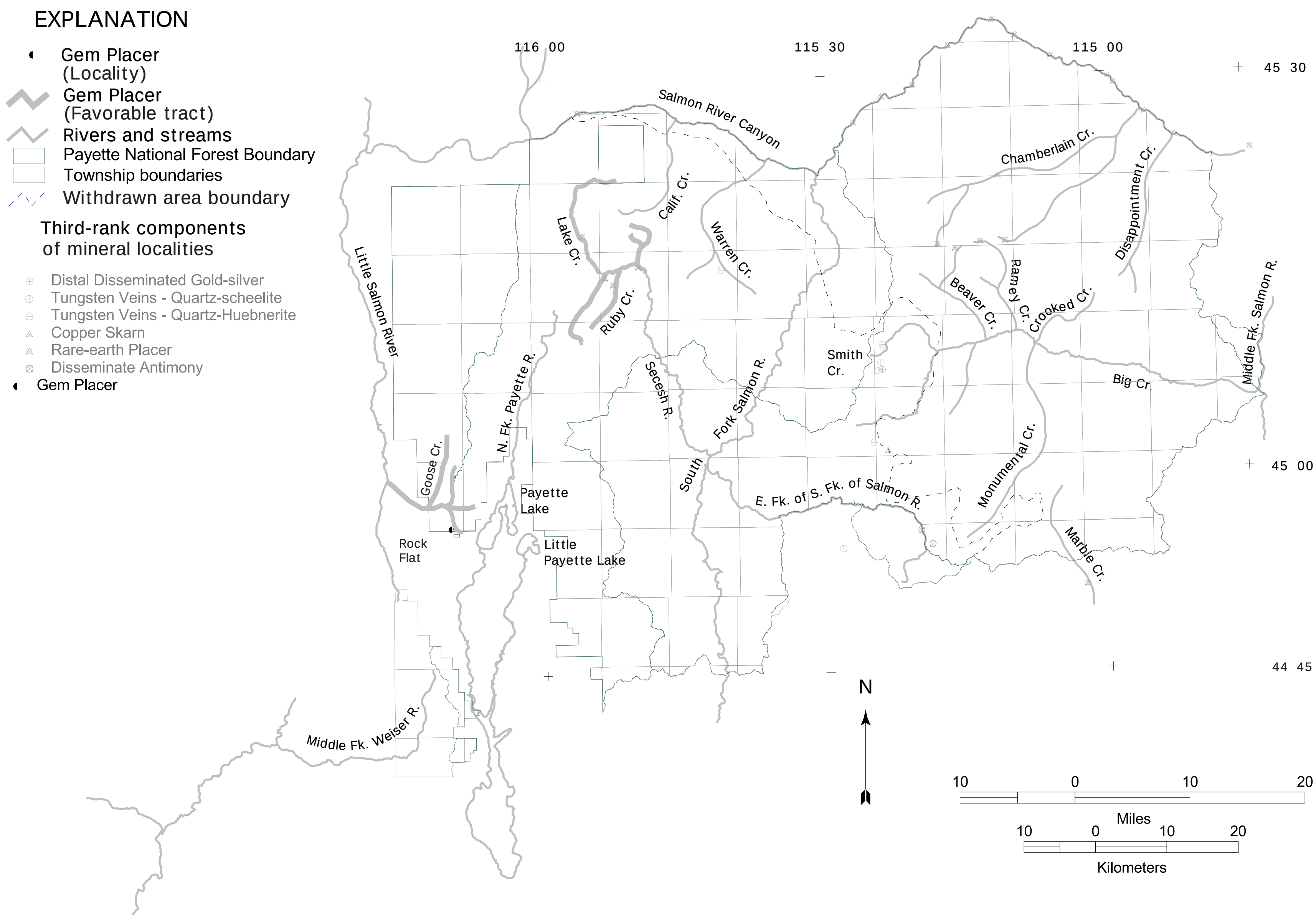


Figure 30. Map showing locality and favorable tracts for Gem Placer, eastern PNF.

LEASABLE MINERAL RESOURCES

Leasable Minerals are withdrawn from acquisition by location, but can be developed through prospecting permits and leases from the U.S. Government (according to the United States Mineral Leasing Act of 1920, as amended from time to time). No permanent rights are acquired from mineral leases, except the right to explore for and mine the specific minerals covered by the lease. The following mineral materials are leasable: oil, gas, coal, oilshale, sodium, potassium, phosphate, native asphalt, solid or semisolid bitumen, bituminous rock, oil-impregnated rock or sand, and sulfur in Louisiana and New Mexico (U.S. Forest Service, 1983). Minor lignitic coal is the only known leasable mineral resource in the PNF.

Coal (lignite)

(by J. David Sanchez)

Description

Coal-bearing seams are present locally in the Payette Formation, which is up to 380 m thick, and consists of conglomerate, arkosic sandstone, volcaniclastic materials, shale, clay, diatomite, and minor lignite. These sediments were deposited in the Weiser embayment, which is the southeastern-most extension of the flood-basalt province, and in intermontane basins. Deposition of sediments occurred in Middle to Late Miocene time, during periods of relative quiescence, between eruptions of basalt flows. The sediments probably were deposited in steams, marshes, and lakes that formed in fault-bounded intermontane basins and (or) where drainages were blocked by basalt flows (Kirkham, 1931; Fitzgerald, 1982).

Examples

Secesh Meadows: At Secesh Meadows in the McCall Ranger District, thin coal beds are present in sedimentary rocks of the Miocene Payette Formation. The coal-bearing sedimentary rocks are preserved in a small half-graben, on the southwest side of the Secesh Valley. The Miocene strata overlie granodioritic rocks of the Idaho Batholith. The coal-bearing sedimentary strata dip about 20^{o} southwest, toward a graben-bounding normal fault, and away from the present stream gravels on the northeast side of the valley (Capps, 1940).

Several outcrops of coal were examined in the Secesh Meadows area. The coal-bearing outcrops are in the War Eagle Mountain 7.5’ quadrangle (S. 10, T. 22 N., R. 5 E.), along the south side of the Secesh River, near a small tributary, which skirts the waste pile of a prospect pit. Two thin coal beds (< 60 cm thick) appear to be present at different stratigraphic horizons. Samples analyzed using a Rock-Eval pyrolysis method indicate that the coal is lignite, with Total Organic Carbon = 48.8 wt percent, T_{max} = 409^{o}C, and hydrogen/oxygen index = 163/99.

EXPLANATION

Coal (Lignite)
(Favorable)

Payette National Forest Boundary

Township boundaries

Other Mineral Localities

- Gold-silver Mixed Metal Veins
- Distal Disseminated Gold-silver
- Antimony Veins
- Tungsten Veins - Quartz-scheelite
- Tungsten Veins - Quartz huebnerite
- Low-sulfide Gold-quartz Veins
- Polymetallic Layers & Veins
- Copper-silver Polymetallic Veins
- Manganese Layers & Veins
- Barite Layers & Veins
- Porphyry Copper-molybdenum
- Copper Skarn
- Iron Skarn
- Disseminated Copper-silver
- Kuroko Zinc-copper Massive Sulfide
- Hot-spring Gold-silver
- Hot-spring Mercury
- Opal and (or) Silica
- Quartz - Pegmatite, Veins
- Mica - Pegmatite, Skarn
- Gypsum (Anhydrite) Lenses
- Gold Placer
- Black-sand Placer
- Rare-earth Placer
- Tungsten Skarn
- Rare-earth Lode
- Disseminated Antimony
- Copper-gold Mixed-metal Veins
- Copper-silver-gold Pegmatite
- Quartz-fluorite Veins
- Magmatic Copper
- Unclassified
- Uranium, undivided

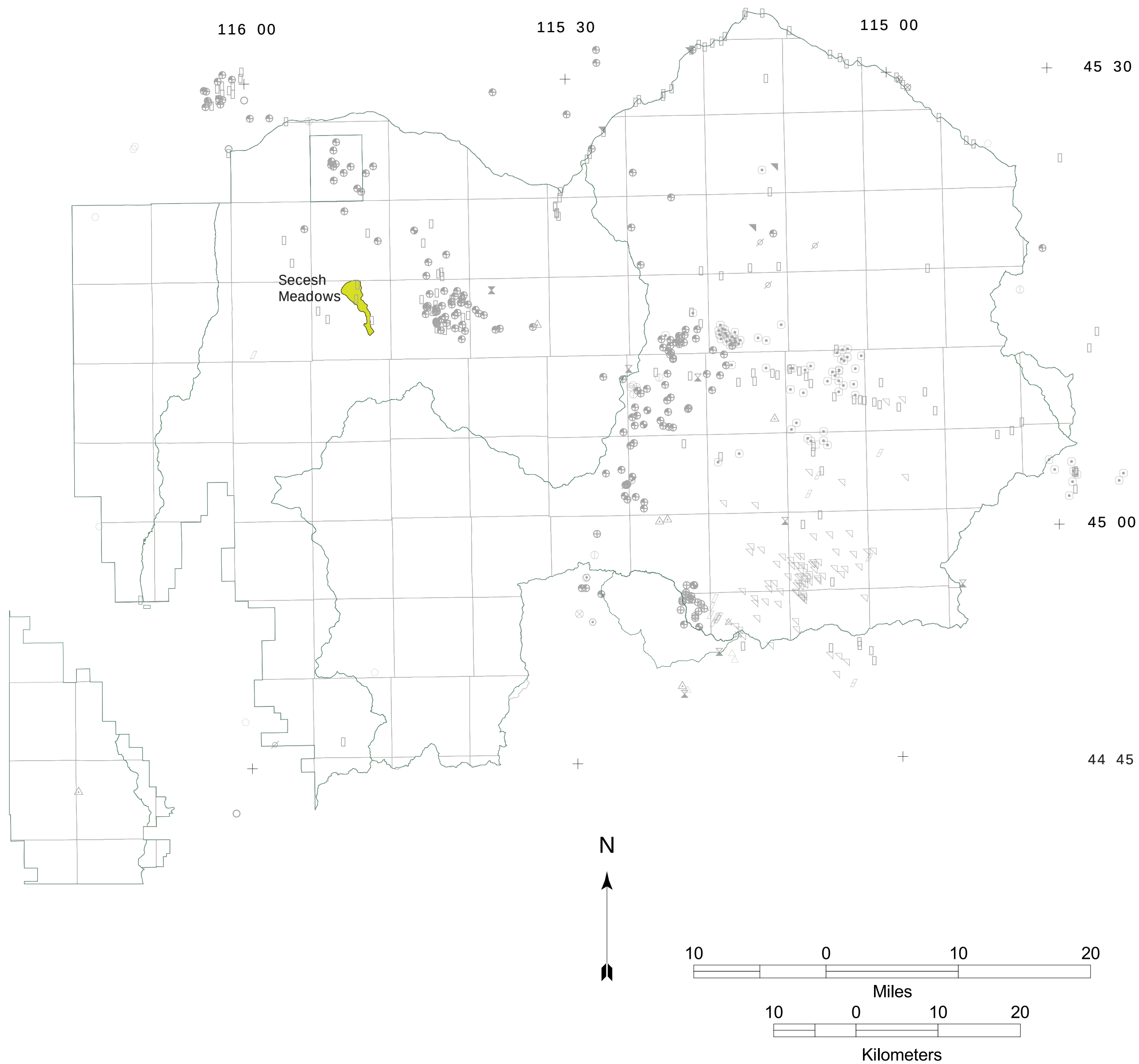


Figure 31. Map showing favorable tract for Coal (lignite), eastern PNF.

Coal localities near PNF: The Payette Formation underlies Quaternary alluvium in Long Valley, and coal has been reported near Norwood Station, which is between McCall and Cascade, and between the east and west parts of the PNF (M.L. Klohn, Exxon Co., written commun. to T.H. Kiilsgaard, 1988). Coal also is present in rocks of the Payette Formation south of PNF, in Boise and Gem Counties (T.H. Kiilsgaard, oral commun., 1997). An outcrop in section 14, T 9 N, R 1 E, contains at least 12 ft of lignite/coal (M.L. Klohn, written commun. to T.H. Kiilsgaard, 1988). The Horseshoe Bend coal field, in the Boise NF, southeast of PNF contains an estimated 17 million tonnes of sub-bituminous to lignitic coal (Wood and Bour, 1988). South and west of PNF, coal-bearing sedimentary rocks of the Payette Formation are exposed near Weiser, Idaho, and Huntington, Oregon (Kirkham, 1931). However, Nakai (1979) measured and described 5 stratigraphic sections in the Payette Formation in Washington County, and reported no coal.

Rationale for Tract Delineation

Fault-bounded alluvial valleys that may contain sedimentary rocks of the Payette Formation may be permissive for coal-bearing sedimentary sequences. However, the thin lignite beds of Secesh Meadows are the only known coal occurrences in the PNF, and reconnaissance efforts to find other coal-bearing rocks in the PNF were unsuccessful. The Secesh Meadows tract (fig. 31) is therefore the only area inside the PNF that the assessment team considered favorable for undiscovered coal resources.

Reason for no Numerical Estimation

Known coal resources of the PNF are small and low-grade, and the potential for undiscovered coal resources is considered low. For that reason and for lack of an appropriate tonnage-grade model, no numerical estimation was made for undiscovered coal resources of the PNF.

Development Forecast

It is unlikely that there will be significant coal exploration or development in the PNF in the foreseeable future.

SALABLE MINERALS AND MINERAL MATERIALS

The United States Materials Act of 1947 (as amended), removes petrified wood, common varieties of sand, stone, gravel, pumice, pumicite, cinders, and some clay from location and leasing (U.S. Forest Service, 1983). These materials may be acquired by purchase only, and are referred to as salable minerals. The definition of salable versus locatable hinges on what is meant by "common varieties." For example, most sand is salable, but high-purity silica sand, required for glass making, is locatable.

Gypsum

deposit code 023

USGS model -- Bedded gypsum: Deposit subtype: Marine evaporite gypsum (model 35ae)

Raup (1991) wrote a USGS descriptive model for bedded gypsum of a marine evaporite subtype (model 35ae). Orris (1992d,e) wrote preliminary grade and tonnage models for marine bedded gypsum (model 35a.5) and lacustrine gypsum (model 35a.9).

Description -- stratiform lenses of chlorite-bearing gypsum in chlorite phyllite and greenstone

Gypsum deposits of the western PNF are present as stratiform lenses of chlorite-bearing gypsum ($CaSO_4.2H_2O$) $\pm$ anhydrite ($CaSO_4$) that are conformable with layering and foliation of enclosing chlorite phyllite and greenstone of the Blue Mountains Island Arc accreted terranes. Hendrickson (1975) noted that the gypsum deposits of Dennett Creek contain copper (15 to 30 ppm) and zinc (25 to 35 ppm),whereas marine-evaporite gypsum contains essentially no copper or zinc.

Interpretation -- evaporite, limestone-replacement, or exhalative anhydrite, weathered to gypsum

McDivitt (1952) suggested that gypsum deposits of Washington County, Idaho formed by hydrothermal replacement of limestone by anhydrite, followed by hydration of anhydrite to gypsum by weathering. Hendrickson (1975) supported this interpretation with the observation that the gypsum of Dennett Creek is at the stratigraphic horizon of the limestone of Dennett Creek. He also cited the copper and zinc contents of the gypsum of Dennett Creek as evidence of a hydrothermal-replacement origin.

An alternative hypothesis is that the Cu- and Zn-bearing gypsum and anhydrite deposits of Dennett Creek are metamorphosed volcanic exhalative deposits, formed at white-smoker hot-spring vents. This idea is based on the observation that the Cu- and Zn-bearing gypsum and anhydrite of Dennett Creek are within the Weatherby Formation (Karen Lund, unpub. data, 1997), which also contains polymetallic layers and veins, interpreted as volcanic-exhalative layers and feeder veins (compare figs 9 and 32). Deposits of the Weatherby. Exhalative anhydrite might have survived in evaporitic lagoons and (or) sabkhas (salt flats). Gypsum probably formed by hydration of anhydrite during weathering.

Example

Dennett Creek gypsum mine: Figure 32 shows the location of an open-pit gypsum mine in the western Hitt Mountains, on the ridge between the main and middle forks of Dennett Creek (N.W. Section 11, T. 14 N., R. 6 W). The mine is in the Weiser Ranger District, and the Mineral mining district. The mine was operated by the Weiser Cooperative, probably in the late 1980’s and early 1990’s, to produce gypsum for local agricultural use as a soil amendment.

Massive beds of white gypsum, up to 1 m thick, are exposed in the open pit. They are interlayered with well-foliated layers of chlorite-bearing gypsum and green chloritic phyllite. The gypsum-bearing strata have a total stratigraphic thickness of about 30 m. They are overlain by chlorite phyllite, and underlain by sheared conglomeratic greenstone of the Weatherby Formation. Layering generally dips about 30^{o} northwest, but there are tight, meso-scale drag folds in the chloritic gypsum and phyllite.

Rationale for Tract Delineation

The oceanic Blue Mountains Island Arc (figs. 4 and 5) is permissive for gypsum. Favorable tracts for gypsum in the PNF are delineated to include all exposures of the Weatherby Formation (Karen Lund, unpub. data), which contains two known gypsum localities in the Hitt Mountains (fig. 32).

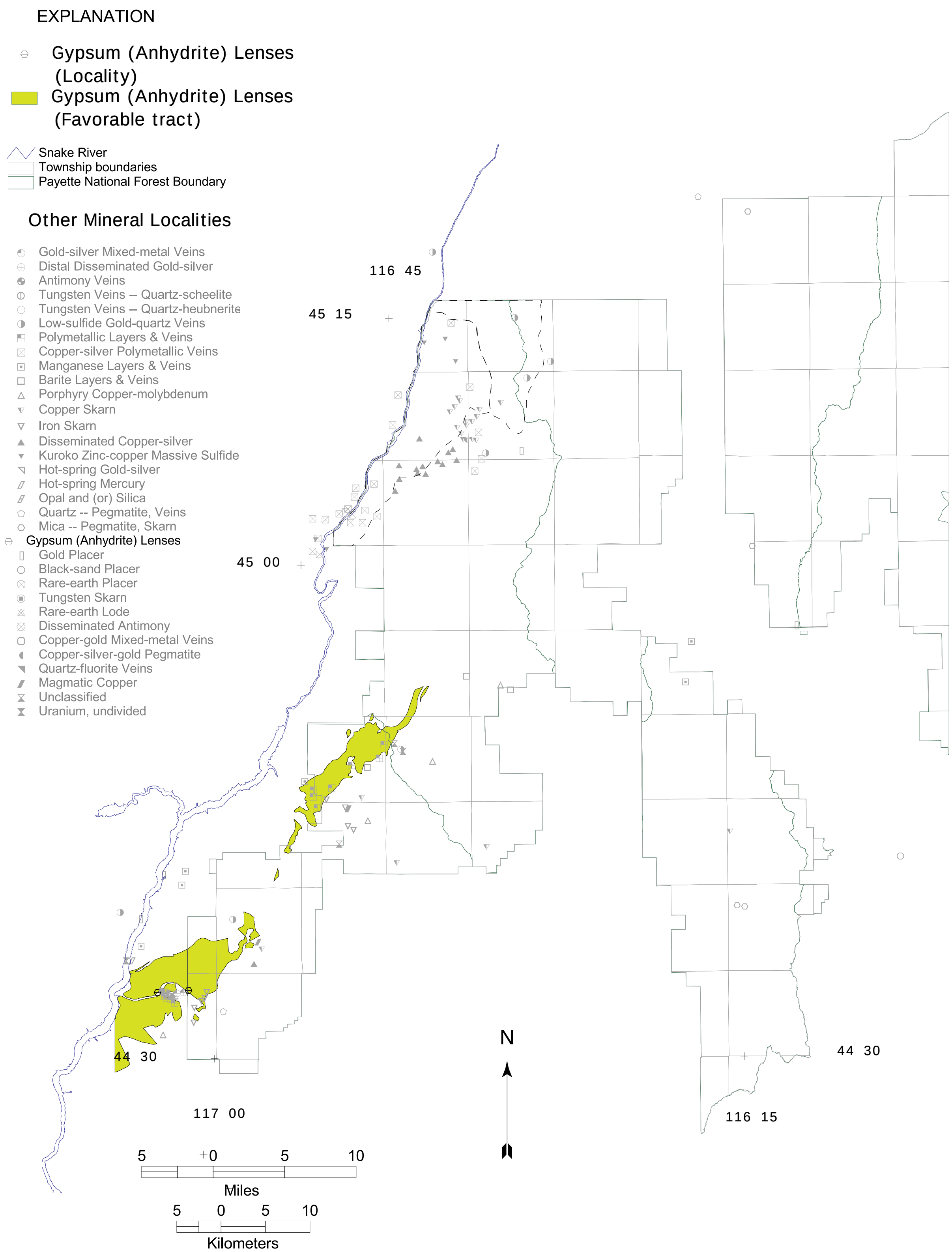


Figure 32. Map showing localities and favorable tracts for Gypsum, PNF.

Reason for no Numerical Estimation

No numerical estimation was made for undiscovered gypsum resources in PNF. The median tonnage-and-grade of the model for marine evaporite gypsum deposits is 280 million tonnes at 90.7 percent gypsum. Median tonnage-and-grade of the model for lacustrine evaporite gypsum is 14 million tonnes at 85 percent gypsum. Compared to these models, the known gypsum deposits of the PNF are relatively small and impure, and they are likely to grade downward to anhydrite.

Development Forecast

It is unlikely that major gypsum mines will be developed in the PNF, because most gypsum, which is calcined to make plaster products, is mined from deposits that are much larger and higher-grade than those of the PNF. However, small-scale mining could be resumed to supply local demand for agricultural gypsum, which provides sulfate, assists in decomposition of potassic silicates, stimulates nitrogen-fixing bacteria, improves soil texture, and converts sodium carbonate to the more soluble sulfate (McDivitt, 1952). The quality of the gypsum from the Dennett Creek mine was acceptable for local agricultural use, but production stopped in the early 1990s, because it became unprofitable (Robert Bryan, USFS, retired, pers. commun., 1994).

Environmental Effects and Implications

Gypsum mining has resulted in surface disturbances at the location of a small open pit mine and its associated waste-rock piles, and haulage road. However, large-scale gypsum mining is not foreseen, and no significant chemical-environmental effects are expected from past or future gypsum mining.

Quartz -- Pegmatite, Vein

deposit code 021

USGS model -- no USGS model

Description -- pegmatite pods with quartz cores, and or quartz-rich veins

Pegmatite pods that have quartz cores, irregular masses of hydrothermal quartz, and quartz-rich hydrothermal veins are small resources of silica, which may be quite pure. Locations of quartz mines and prospects in PNF are shown on fig. 26 and pl. 1.

Examples

Crystal Mountain: The Crystal Mountain quartz mine is about 2 km northeast of Burgdorf, in the McCall Ranger District. White quartz was mined from the massive quartz core of a large pegmatite pod. White quartz is exposed in the dormant quarry, which is on a hilltop, and is roughly circular, with a diameter of about 150 m. The white quartz is fractured, and the fractures are variably limonite-stained. At the margins of the quarry, the white quartz contains biotite books, and pods of aplite and pegmatite, which consist of quartz, feldspar and biotite. Contacts between pegmatite-aplite and quartz are cuspate and inter-digitated. Minor sericite and pyrite also are present along the margins of the quartz core. The quartz-cored pegmatite pod of Crystal Mountain is surrounded by foliated biotite granodiorite of the Idaho Batholith.

Silica: The Silica mine is near Fourth of July Creek of the Hitt Mountains, in the Weiser Ranger District. The prospect consists of a side-hill open pit, about 100 m long and 50 m across. The pit follows a body of white quartz, which contains scattered radial clusters of black tourmaline up to 30 cm across. The quartz body is irregular in shape and has a maximum width of about 30 m. It is tentatively interpreted as the quartz-rich core of a pegmatite body in a small exposure of Jurassic-Cretaceous granodiorite, overlain by Imnaha basalt.

Jacobs: The Jacobs quartz-crystal pegmatite (or vein) occurrence is on Jug Handle Mountain in the southwest part of the Krassel Ranger District, southeast of McCall. The quartz pegmatite (or vein) cuts porphyritic muscovite-biotite granite of the Idaho Batholith. Large quartz crystals are reported to have been produced and tested as a possible source of piezoelectric-grade quartz, used in electronic and optical applications. “Two hundred tons of quartz was mined from the deposit in 1949 and used as brick facing, but there is no record of any of the quartz ever having been used as piezoelectric quartz” (Kiilsgaard, 1995, p. 141). Small tonnages of massive quartz remain to be mined, according to Carter and Savage (1964),.

Development History and Forecast

The Crystal Mountain mine claims were staked as a locatable resource of high-purity silica for use as smelter flux. However, the silica failed to meet the standards of chemical purity set by the smelter. Thereafter, the quartz was crushed and used as a salable commodity, to armor local roads. However, the crushed quartz is less than ideal for that purpose, because fragments of crushed quartz tend to have hard, sharp edges, which tend to cut and abrade rubber tires.

Quartz-rich pegmatites and veins of the PNF represent very small and remotely located sources of silica of variable and marginal purity. It is unlikely that exploration and development of such resources will occur in the foreseeable future. Nevertheless, the white quartz of Crystal Mountain may continue to serve as a local source of crushed rock in the Burgdorf-Secesh Meadows area.

It is unlikely that quartz from the silica mine will be widely used as crushed rock for road armor, because basalt flows of that area provide superior crushed rock for that purpose. Nevertheless, white quartz of the silica mine might find a market as decorative crushed rock, because unlike quartz of the Crystal Mountain mine, that of the Silica mine is not significantly limonite-stained.

Environmental Effects and Implications

Quartz mining has resulted in surface disturbances at the locations of two small open-pit mines and their associated waste-rock piles, and access roads. However, large-scale quartz mining is not predicted, and no far-reaching chemical-environmental effects are expected from past or future quartz mining.

Mica -- Pegmatite
deposit type 022

USGS model -- no USGS model

Description -- sheet mica and scrap mica in pegmatites

Pegmatites commonly contain coarsely crystalline quartz, feldspar, and mica ± accessory minerals, such as garnet, tourmaline, and beryl. Mica minerals commonly found in pegmatites are muscovite (white mica), which may have commercial value, and biotite (black mica), which has no commercial value (Lesure, 1973). In Idaho, mica-bearing pegmatites are present in marginal parts of the Idaho Batholith and its metasedimentary host rocks (Stoll, 1950). Locations of mica mines and prospects in PNF are shown on figure 26 and plate 1.

Examples

Mica Queen: The Mica Queen mine is in the West Mountains, in the New Meadows Ranger district, about 17 km southeast of the town of Council, on the north side of the valley of the Middle Fork of the Weiser River. From pegmatites hosted in gneissic quartz diorite or granodiorite, the mine produced about 90 kg of mica in 1918 and 452 kg of mica in 1944 (Stoll, 1950, p. 10) The pegmatite bodies, at least three of which have been mined, contain quartz, oligoclase, muscovite flakes and books, and accessory biotite and garnet. Muscovite is of three types: (1) fine, white, scaly mica, dispersed through the pegmatite; (2) books of light green mica, as large as 13 cm; and (3) greenish brown mica. The Stites mica prospect is near and similar to the Mica Queen mine.

OK: The OK mica prospect is in the northwest corner of the eastern part of the New Meadows Ranger District, on the west side of the valley of Lake Creek, about 10 km southeast of Riggins. Mica is present in pegmatite, hosted in biotite gneiss and schist of the Salmon River suture zone. Much of the mica is flat and free-splitting. Some sheets are clear and others are black-stained. Their color is green and greenish brown.

Clark: The Clark mica prospect is just outside the PNF, near the southwest boundary of the eastern part of the New Meadows Ranger District, about 4 miles northeast of New Meadows, on Fourmile Creek, a tributary to the Little Salmon River. It consists of several open cuts on two pegmatites, which contain iron-stained mica books, hosted in gneissic plutonic rocks of the Idaho Batholith in the Salmon River suture zone.

Development Forecast

No development is predicted for mica deposits of the PNF in the foreseeable future. Because of the high cost of hand labor required, and the increasing use of substitutes for sheet mica, a drastic reduction in demand for sheet mica is predicted by the year 2000 (Petkof, 1970). Future needs for scrap mica probably will be supplied by scrap from foreign sheet mica operations, and from large-tonnage, low-grade mica-schist deposits (Lesure, 1973). The Mica Queen mine is small, and Stoll (1950) judged that the most promising mica pegmatites were mined in 1944. Other mica pegmatite prospects in the PNF probably have less potential than the Mica Queen pegmatites.

Environmental Effects and Implications

Mica mining has resulted in surface disturbances at the locations of small mines and their associated waste-rock piles and access roads. However, large-scale mica mining is not expected, and no significant chemical-environmental effects are expected from past or future quartz mining.

Dimension Stone

Relatively unaltered and unweathered rocks of the Idaho Batholith, and (or) porphyritic rocks of Tertiary intrusions could be quarried and cut for dimension stone. However, no large dimension-stone quarries are present in the PNF. The distance from major markets, the lack of local stone-cutting infrastructure, and the lack of particularly sought-after dimension stone mitigate against future development of a dimension-stone industry in the PNF.

Decorative Stone

Description and Examples

Decorative stone is used in stone facings on structures, such as walls and fireplaces, and in landscaping. Almost any rock that is relatively durable can be used as a decorative stone, depending on the artistic judgment of potential producers and customers.

Basalt columns have recently become popular as decorative stones, used mostly in landscaping. Cobble- to boulder-sized basalt fragments also are commonly used as building stones for rustic stone walls, foundations, fireplaces, and chimneys. Both are widely distributed in the western PNF.

“Moss rock,” and “river rock” are popular decorative stones, which are used in landscaping and in rustic stone walls, foundations, fireplaces and chimneys. Talus slopes are a common source of lichen-coated “moss rock.” Dredge spoils and upstream glaciofluvial and alluvial deposits are convenient sources of rounded “river rock,” especially in the eastern PNF.

White “bull quartz” is a popular decorative stone that may be used in large pieces or in crushed form. The Crystal Mountain, Jacobs, and Silica quartz deposits are described under Quartz -- Pegmatite, Vein (deposit code 021).

Development Forecast

Future development of potential decorative-stone resources is difficult to predict, because the popularity of any particular type of stone depends greatly on passing fashions, and (or) on the marketing abilities of the potential producer, both of which are difficult to predict. Local demand probably will continue for rustic building stone, such as basalt, “moss rock,” and “river rock.” However, development of such resources may occur preferentially on privately held lands, outside the National Forest System, where commercial development may be less costly and complicated.

Crushed Stone

Description and Examples

Basalt: Basalt is dark colored, fine-grained mafic igneous rock, composed mostly of calcic plagioclase feldspar and iron- and magnesium-bearing silicate and oxide minerals. Basalt flows are extrusive, but basaltic dikes are intrusive. Much of the western part of the PNF is covered by basaltic lava flows of the Weiser Embayment of the Columbia River Basalt Province (fig. 5, and Karen Lund, unpub. data). Successive basalt flows commonly are separated by soil zones, and locally are interbedded with alluvial and (or) lacustrine sediments.

Basalt is preferred over all other rock as a source of crushed rock for road metal in Idaho, and basalt is abundant in the western part of the PNF, especially in the Weiser, Council, and New Meadows Ranger Districts. The most suitable basalt for crushed rock is fractured basalt that is somewhat weathered, so that its feldspars and pyroxenes are partly altered to softer clay minerals. Fractured and weakly altered basalt, which "pangs" when hammered, is relatively easy to mine and crush, but it is tough and makes excellent road material. It tends to break into fragments that are angular, but not too sharp-edged. Relatively massive, unfractured, unaltered, and unweathered basalt that "pings" when hammered is difficult to crush, and tends to break with conchoidal fracture to form fragments with sharp edges that can cut tires. Strongly altered or weathered basalt that "pongs" or "thuds" when hammered is too soft for use as crushed-rock aggregate (James Shelden, USFS, pers. commun., 1996).

Other rock types: Many other rock types are suitable for use as crushed-rock aggregate, if they are relatively unaltered and unweathered. Metamorphic rocks may be suitably competent, but they may tend to break along metamorphic foliation planes to produce platy fragments that are hard on tires. Fine-grained igneous rocks probably are preferable to coarsely crystalline igneous rocks, which may tend to break along crystal boundaries. Relatively unaltered rocks, found outside mining districts, are likely to be more suitable for crushed rock than the hydrothermally altered rocks that are common within mining districts. Quartz, from quartzite, pegmatite, veins and silicified rocks, is competent but hard to crush, and it breaks with conchoidal fracture to produce sharp and abrasive fragments.

Talus and Alluvium: Talus and alluvium that contain boulders, blocks, or cobbles of competent rocks (such as relatively unaltered, unweathered igneous or metamorphic rocks) are potential sources of rock that is suitable sources for crushed-rock aggregate.

Alluvial placer spoils: Alluvial placer spoils may be an excellent source for boulders, cobbles and gravel that can be crushed to produce crushed-rock aggregate.

Rationale for Tract Delineation

The area covered by Columbia River Basalt in the western PNF is permissive for basalt that is suitable for crushed-rock aggregate (fig. 5 and Karen Lund, unpub. map, 1997). However, suitability for aggregate was not a criterion for delineation of map units, and individual flows and their fracture characteristics were not mapped. Nevertheless, locations of known crushed-rock sources could be compiled from PNF road engineering files, and combined with trends of contacts between mapped subunits of Columbia River basalt, to delineate favorable tracts for basalt that is suitable as a source for crushed-rock aggregate.

In the eastern PNF, areas mapped as igneous intrusive and (or) metamorphic rock, are permissive for relatively competent rocks that may be suitable for use as crushed rock (Karen Lund, unpub. map, 1997). As sources of crushed-rock aggregate, relatively unaltered rocks outside of mining districts are likely to be better than the altered rocks of mining districts. Talus, alluvium, and placer spoils are potential source materials for crushed-rock aggregate.

Development Forecast

Demand for and development of crushed-rock aggregate sources is expected, as long as roads are developed and maintained in the PNF. Locations of such demand and development will be determined by locations of existing roads and needs for new roads.

Environmental Effects and Implications

Environmental effects of quarries in relatively stable, unmineralized bedrock are restricted to the area disturbed by the pit, and its waste dump and access road. However, environmental effects of undercutting unstable talus slopes can lead to catastrophic landslides, increased rates of down-slope movement (mass wasting), erosion, and down-stream sedimentation. Use of alluvium as a source of crushed rock may also lead to increased erosion and down-stream sedimentation. However, use of alluvium in areas already disturbed by placer mining may provide opportunities to improve disturbed landscapes.

Sand-and-gravel

USGS model -- Surficial sand and gravel deposits

Bliss (1993) modeled volume, area, and thickness of sand and gravel deposits of a wide range of types, from a wide range of depositional environments, including alluvial fans, stream beds, stream terraces, glacial terraces, outwash plains, eskers, kame terraces, and beaches (modern and raised). He also outlined strategies for modeling physical of attributes of sand and gravel, such as particle sizes, particle geometries, cleanness, soundness, chemical reactivity, etc.

Bliss and Page (1994) showed that sand and gravel deposits in alluvial fans have a median volume of 35 million m^3. Deposits in all other geologic settings have a median volume of 5.4 million m^3, a median area of 120 ha, and a median thickness of 4 m. They also outlined a system for classification of deposits by fragment size by percentage of sand, gravel and silt within the deposits.

Description -- unconsolidated sand and gravel

Gravel-sized particles range from 2 to 75 mm, and sand-sized particles range from 0.06 to 2 mm (Bates and Jackson, 1987). Sand and gravel deposits are surficial accumulations of relatively unconsolidated sand and gravel in which gravel is 25 percent or more by weight (Bliss and Page, 1994).

Interpretation -- fluvially transported, sorted, and deposited sand and gravel

Moving water is the principal geologic agent that affects the distribution of deposits of sand and gravel. Therefore, sand and gravel deposits tend to be found in present or past water courses. Unsorted colluvium (formed by weathering, down-slope creep and sheetwash) is moved into high-gradient streams, where fragments are transported, abraded, rounded, and sorted. Differential transport and sorting take place in water as a function of the interplay between water velocity and particle size (assuming equivalent density, shape, and cohesion). As water velocity increases, particles are moved in order of increasing hydraulic equivalency (size x density). As water velocity decreases, particles are deposited in order of decreasing hydraulic equivalency.

Sand-and-gravel can accumulate wherever gravel-transporting water velocities slacken. In general, maximum grain sizes tend to decrease down-stream. Upstream tributaries with high gradients tend to have coarse alluvium with boulders, cobbles, gravel sand and silt, whereas downstream reaches, near local baseline lakes, tend to have finer alluvium with gravel, sand and silt. Small accumulations of sand-and-gravel can form behind obstacles and (or) in relatively flat segments of almost any mountain stream, especially during waning stages of high-flow events. Voluminous sand-and-gravel accumulations tend to form where stream-gradients flatten and (or) valley bottoms widen. In such locations, deposition of sand and gravel tends to block stream channels, diverting flow and leading to formation of alluvial fans and (or) braidplains. Large accumulations of sand and gravel tend to accumulate where such conditions persist over time.

Examples

Most sand and gravel deposits of the PNF and vicinity are glaciofluvial or alluvial in origin. *Glaciofluvial sand-and-gravel* deposits form as unsorted glacial till that is transported, sorted, and re-deposited by streams of meltwater. *Alluvial sand and gravel* deposits formed in non-glaciated areas that are mountainous or hilly, and (or) in non-glacial times.

Western PNF: Sizeable resources of sand-and-gravel are in wide valleys, which separate the mountainous areas of the western PNF. Examples are the Meadows Valley (on the Little Salmon River) and the valley of Council, on the Weiser River. Most of the land in those valleys lies outside the PNF, and is privately owned. Sand-and-gravel resources are present in alluvium, alluvial terraces, and alluvial fans in those valleys. Relatively narrow, v-shaped valleys within the mountainous western PNF have relatively insignificant resources of sand-and-gravel. Nevertheless, limited amounts of sand-and-gravel are locally available from alluvium and alluvial terraces of persistent streams, such as the upper Weiser River in the West Mountains, Indian Creek in the Seven Devils Mountains, East Brownlee Creek in the Cuddy Mountains, and Middle Brownlee Creek and Fourth of July Creek in the Hitt Mountains.

Eastern PNF: Plentiful high-quality glaciofluvial sand-and-gravel resources are present in upper Long Valley, south of McCall, and outside the PNF, on nearby private land, and on Federal land, administered by the Bureau of Land Management (BLM). Several gravel pits are in the floodplain of the braided and meandering South Fork of the Payette River, which cuts across terminal and recessional moraines, and glacial outwash deposits of Late Pleistocene age.

Fairly large, good-quality sand-and-gravel resources, in the form of glaciofluvial and alluvial braidplain deposits, also are present in relatively wide meadows, like those of Squaw Meadows (on Summit Creek), the meadows near Burgdorf (on Lake Creek), Secesh Meadows (on the Secesh River), Warren Meadows (on Warren Creek), and the meadows near Edwardsburg (on Big Creek).

Sand-and-gravel resources also are present in alluvial terraces, along relatively large creeks and rivers, such as the North Fork of the Payette River, the South Fork of the Salmon River, the East Fork of the South Fork of the Salmon River, Big Creek, and the Middle Fork of the Salmon River.

Rationale for Tract Delineation

Stream-valley bottoms, and surficial deposits of unconsolidated sediments of Quaternary age, mapped by Karen Lund, (unpub. data, 1997), are permissive for sand-and-gravel resources, Those that are in relatively flat, wide valley bottoms are favorable for large-scale resources of sand-and-gravel.

Reason for no Numerical Estimation

Numerical estimation of sand and gravel resources of the PNF was considered beyond the scope of this mineral-resource assessment of the PNF when the assessment team met in 1994. Nevertheless, tools to accomplish such an estimation are now available. Bliss and Page (1994) compiled volumetric models for sand and gravel deposits, based on volumes of 274 deposits (151 in the United Kingdom, and 123 in California). They found that the volume of a sand and gravel deposit can be predicted from its area using the regression: $\log[\text{volume}(\text{million m}^3)] = -1.45 + 1.07 \log[\text{area (ha)}]$. Classifying deposits by fragment size can be done using models of the percentage of sand, gravel, and silt within the deposits, according to a classification scheme presented by Bliss and Page (1994).

Development Forecast

Abundant sand and gravel resources are available on non-USFS lands near towns in broad valleys near the PNF. Therefore, demand for sand and gravel within the PNF will be for construction within the PNF and far from the forest boundaries. In general, such demand will be for relatively small-scale construction projects, and (or) for road gravel. The extent to which sand and gravel resources within the PNF will be developed will have to be determined by balancing environmental effects of each proposed sand-and-gravel operation versus savings in costs of transportation from more distant sites, outside the PNF. In contrast to other mineral-deposit types, sand-and-gravel deposits can have minor renewal, especially during floods (Bliss and Page, 1994).

Environmental Effects and Implications

Environmental effects of sand-and-gravel recovery vary greatly with the location and size of the operation. Disturbance of a stream channel, its banks, and (or) its riparian zone will temporarily increase turbidity, and locally change affected fluvial and riparian habitats. However, local environmental effects of some relatively small-scale sand-and-gravel operations may be repaired by renewal of the resource, especially during floods.

ACKNOWLEDGMENTS

PNF Minerals Program Manager, James Egnew, and his predecessor, Robert Brian, as well as Krassel District geologist Laurie Kelso, and her predecessor, Jane Wurster, and mining-operations inspector John Gebhard have all assisted in this study by generously sharing their knowledge of minerals-related activities in the PNF.

The following mine operators, geologists, and mineral explorationists have generously allowed access, provided mine tours, and helped to inform us about the geology and mineral resources of the PNF: Donald Bork, Paul Turner, and Bart Stryhas (of Stibnite Mine, Inc.), Eric Jones (of Hecla and Stibnite Mine, Inc.), and Rob Mullener (of Boise State University), in the Stibnite subdistrict of the Yellow Pine district; Ben Leonard (USGS retired) in the Yellow Pine district; Vance Thornsberry (consultant), Peter Parsely (of USMX and Dakota Mines), and James Collard (of Thunder Mountain Gold) in the Thunder Mountain district; James Collard in the Ramey Ridge and Big Creek districts; Stuart Moller (consultant), Jack Walker (Walker Mining Co.), and Jerry and Letty Tucker (Heritage Mines) in the Edwardsburg district; James Striker and Bruce McKenna (Rescue decline), and William Hommel (Unity mine) in the Warren district; Rodney Johnson and Douglas Baker (Alberta mine), and Peter Laczy in the Marshall Lake district, and Gary Cummings (Alta Gold) at the Copper Cliff mine in the Seven Devils district.

USGS physical scientist Dave Frank pulled relevant records from the USGS Mineral Resources Data System and helped with generation of spread sheets and maps. US Bureau of Mines geologists Eric Cather, Charles Bishop, and Thomas Hillman made USBM data on known mineral production and resources available to USGS. As a USGS term employee, Woodrow Campbell (formerly of USBM) transferred USBM digital files on PNF to USGS. Using USGS data, he also made preliminary GIS coverages for mineral localities and favorable tracts. USGS mineral-resources statisticians William Scott and Gregory Spanski supplied new Mark 3 simulations for Distal Disseminated Gold-silver and Disseminated Antimony deposits, using updated tonnage-grade models. They also made new Mark 3 simulator runs for the revised estimation of total undiscovered metals. Gregory Spanski also demonstrated how to interpret the Mark 3 output, and suggested the tabular format that was used to summarize the Mark 3 results. USGS geochemist Elwin Mosier provided training and assistance in mine-drainage water sampling. USGS geochemist Laurie Balistrieri helped with calculation and interpretation of alkalinity, based on field titrations.

Student field geologists, working summers for USGS under an agreement with the National Association of Geology Teachers (NAGT), participated as follows: Michael Alter helped with field work in 1993, and Glenn Spinelli compiled water geochemical data in 1996. Volunteer George Haselton helped with field work in 1993, and volunteer Julie Bookstrom helped with water sampling in 1995.

Eastern Washington University students, working part-time for USGS, participated as follows: Andrew Knowles digitized tract boundaries; Evan Arntzen updated the mineral-resource database according to PNF field maps and notes; John Wallis put available production and resource data into preliminary tabular form; and Pat Blair prepared final illustrations, using Adobe Illustrator to label and caption maps derived from ARC/INFO coverages and(or) ARCVIEW files.

USGS Mineral Resource Surveys Program geologists, Gary Winkler, Thor Kiilsgaard (emeritus), and Michael L. Zientek reviewed this manuscript for the U.S. Geological Survey, and offered many helpful suggestions for its improvement.

REFERENCES CITED

Adams, J.W., 1968, Rhabdophane from a rare-earth occurrence, Valley County Idaho, *in* Geological Survey Research 1968: U.S. Geological Survey Professional Paper 600-B, p. B48-B51.

Adams, O.F., 1985, Geology and ore deposits of the Thunder Mountain mining district, Valley County, Idaho: Reno, University of Nevada, M.S. thesis.

American Mines Handbook, 1994, Southam Magazine and Information Group, Don Mills, Ontario, Canada (annual).

Anderson , A.L., and Wagner, W.R., 1952, Reconnaissance geology and ore deposits of the Mineral district, Washington County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 95, 26 p.

Bailey, E.H., 1964, Mercury, *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 180.

Bailey, E.H., and Smith, R.M., 1964, Mercury -- Its occurrence and economic trends: U.S. Geological Survey Circular 496, 11 p.

Bailey, E.H., Clark, A.L., and Smith, R.M., 1973, Mercury, *in*. Brobst, D.A. and Pratt, W.P., eds., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 401-414.

Barton, P.B., Ludington, Steve, Ayuso, R.A., Gamble, B.R., John, D.A., Brew, D.A., Lindsey, D.A., Force, E.R., Goldfarb, R.J., and Johnson, K.M., 1995, Recommendations for assessments of undiscovered mineral resources: U.S. Geological Survey Open-File Report 95-82, 77 p.

Bates, R.L., and Jackson, J.A., 1987, Glossary of geology: American Geological Institute, Alexandria, Virginia, Third Edition, 788 p.

Berger, B.R., 1986a, Descriptive model of low-sulfide Au-quartz veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 239.

Berger, B.R., 1986b, Descriptive model of hot-spring Au-Ag, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 143-144.

Berger, B.R., and Singer, D.A., 1992, Grade and tonnage model of hot spring Au-Ag, *in* J.D. Bliss, ed., Developments in Mineral Deposit Modeling: U.S. Geological Survey Bulletin 2004, p. 20-25.

Beuhler, A.R., Linne, J.M., Causey, J.D., and M.S. Miller, 1993, Mineral resources of the Secesh study area, Idaho and Valley counties, Idaho: U.S. Department of the Interior, Bureau of Mines, Mineral Land Assessment Open-File Report 9-93, 54 p., 5 Appendices.

Bishop, E.M., 1995, Mafic and ultramafic rocks of the Baker terrane, eastern Oregon, and their implications for terrane origin, *in* Vallier, T.L., and Brooks, H.C., eds., Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: Petrology and Tectonic Evolution of Pre-Tertiary Rocks of the Blue Mountains Region: U.S. Geological Survey Professional Paper 1438, p. 221-245.

Bliss, J.D., 1986, Grade and tonnage model of low-sulfide Au-quartz veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 239-243.

Bliss, J.D., 1992a, Grade and tonnage model of Chugach low-sulfide Au-quartz veins, in Bliss, J.D., ed., Developments in mineral deposit modeling: U.S. Geological Survey Bulletin 2004, p. 44-46.

Bliss, J.D., 1992b, Grade, tonnage, and deposit-specific models of diamond kimberlite pipes: in Orris, G.J., and Bliss, J.D., Industrial Minerals Deposit Models: Grade and Tonnage Models: U.S. Geological Survey Open-File Report 92-437, p. 5-10.

Bliss, J.D., 1993, Modeling sand and gravel deposits--initial strategy and preliminary examples: U.S. Geological Survey Open-File Report 93-200, 31 p.

Bliss, J.D., 1994, Mineral deposit modeling using components for complex mineral deposits: Mixed base- and precious-metal veins of the Idaho Batholith, Idaho: U.S. Geological Survey Open-File Report 94-690, 53 p.
Bliss, J.D., and Cox, D.P., 1986, Grade and tonnage model of polymetallic veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 125.
Bliss, J.D., and Orris, G.J., 1986a, Descriptive model of simple Sb deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 183.
Bliss, J.D., and Orris, G.J., 1986b, Grade and tonnage model of simple Sb deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 184-186.
Bliss, J.D., and Orris, G.J., 1986c, Grade and tonnage model of disseminated Sb deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 187.
Bliss, J.D., and Page, N.J., 1994, Modeling surficial sand and gravel deposits: Nonrenewable Resources, v. 3, no. 3, p. 237-249.
Bookstrom, A.A., Zientek, M.L., Box, S.E., Derkey, P.D., Elliott, J.E., Frishman, David, Ashley, R.P., Evarts, R.C., Stoeser, D.B., Moyer, L.A., Cox, D.P., and Ludington, Steve, 1996, Status and metal content of significant metallic mineral deposits in the Pacific Northwest: a contribution to the Interior Columbia Basin Ecosystem Management Project: U.S. Geological Survey Open-File Report 95-688, 93 p., 5 appendices.
Box, S.E., Bookstrom, A.A., Zientek, M.L., Derkey, P.D., Ashley, R.P., Elliott, J.E., and Peters, S.G., 1996, Assessment of undiscovered mineral resources in the Pacific Northwest: A contribution to the Interior Columbia Basin Ecosystem Management Project: U.S. Geological Survey Open-File Report 95-682, 282 p., 4 appendices.
Brew, D.A., 1992, Decision points and strategies in quantitative probabilistic assessment of undiscovered mineral resources: U.S. Geological Survey Open-File Report 92-307, 22 p.
Brobst, D.A., and Pratt, W.P., 1973, United States mineral resources: U.S. Geological Survey Professional Paper 820, 722 p.
Bruce, W.R., 1971, Geology, mineral deposits, and alteration of parts of the Cuddy Mountain district, western Idaho: Ph.D. thesis, Oregon State University, 165 p.
Bussey, S.D., and LeAnderson, J.P., 1994, Geology of the Iron Dyke Mine and surrounding Permian Hunsaker Creek Formation, *in* Vallier, T.L., and Brooks, H.C., eds., Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: Stratigraphy, physiography, and mineral resources of the Blue Mountains Region: U.S. Geological Survey Professional Paper 1439, p. 151-181.
Cannon, R.S., Jr., and Grimaldi, F.S., 1953, Lindgrenite and cuprotungstite from the Seven Devils district, Idaho: American Mineralogist, v. 38, p. 903-911
Cannon, W.F., and Force, E.R., 1985, A strategy in the exploration for sedimentary manganese ores: U.S. Geological Survey Circular 949, p. 4-5.
Cannon, W.F., and Force, E.R., 1986, Descriptive model of sedimentary Mn, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 231.
Capps, S.R., 1940, Gold placers of the Secesh Basin, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 52, 42 p.
Capps, S.R., 1941, Faulting in western Idaho, and its relation to the high placer deposits: Idaho Bureau of Mines and Geology Pamphlet 56, 20 p.
Carter, W.D., and Savage, C.N. 1964, Mineral resources - Silica, *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 180.

Cater, F.W., Pinckney, D.M., Hamilton, W.B., and Parker, R.L., U.S. Geological Survey, and by Weldin, R.D., Close, T.J., and Zilka, N.T., U.S. Bureau of Mines, 1973, Mineral resources of the Idaho Primitive Area and vicinity, Idaho, an evaluation of the mineral potential of the area, with a section on the Thunder Mountain District, by B.F. Leonard, U.S. Geological Survey, and a section on Aeromagnetic Interpretation by W. E. Davis, U.S. Geological Survey: Studies Related to Wilderness -- Primitive Areas: U.S. Geological Survey Bulletin 1304, , 431 p.

Clark, Sandra, and Orris, G.J., 1991, Vein barite, *in* Orris, G.J. and Bliss, J.D., Some Industrial Deposit Models: Descriptive Deposit Models: U.S. Geological Survey Open-File Report 91-11A, p. 19-20.

Clark, Sandra, and Orris, G.J., 1991, Sedimentary exhalative barite, *in* Orris, G.J. and Bliss, J.D., Some Industrial Deposit Models: Descriptive Deposit Models: U.S. Geological Survey Open-File Report 91-11A, p. 21-22.

Close, T.J., 1993, Mineral resources of the Rapid River study area, Adams County, Idaho: U.S. Department of the Interior, Bureau of Mines Mineral Land Assessment Open-File Report MLA 28-93, 120 p.

Cook, E.F., 1954, Mining geology of the Seven Devils region: Idaho Bureau of Mines and Geology Pamphlet 97, 22 p.

Cookro, T.M., 1985, Depositional controls of breccia-fill and skarn tungsten deposits in the Challis Quadrangle: *in* D.H. McIntyre, ed., Symposium on the Geology and Mineral Deposits of the Challis 1^o x 2^o Quadrangle, Idaho: U.S. Geological Survey Bulletin 1658 A-S, p. 193-201.

Cookro, T.M., Silberman, M.L., and Berger, B.R., 1988, Gold-tungsten-bearing hydrothermal deposits in the Yellow Pine mining district, Idaho: *in* Schafer,R.W., Cooper, J.J., and Vikre, P.G., eds., Bulk mineable precious metal deposits of the western United States, Symposium Proceedings, the Geological Society of Nevada, Reno, Nevada, p. 577-624.

Cooper, J.R., 1951, Geology of the tungsten, antimony, and gold deposits near Stibnite, Idaho: U.S. Geological Survey Bulletin 969-F, p. 151-197.

Cox, D.P., 1986a, Descriptive model of polymetallic veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 125.

Cox, D.P., 1986b, Descriptive model of sediment-hosted Cu, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 205.

Cox, D.P., 1986c, Descriptive model of Fe skarn deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 94.

Cox, D.P., 1986d, Descriptive model of porphyry Cu-Mo, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 115.

Cox, D.P., 1986e, Descriptive model of Porphyry Cu, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 76.

Cox, D.P., 1986f, Descriptive model of diamond pipes, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p.54.

Cox, D.P., 1986g, Descriptive model of diamond pipes, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p.54.

Cox, D.P., 1986h, Descriptive model of W skarn deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p.55.

Cox, D.P., 1986i, Descriptive model of Zn-Pb deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p.90.

Cox, D.P., 1992, Descriptive model of distal disseminated Ag-Au, in Bliss, J.D., ed., Developments in mineral deposit modeling: U.S. Geological Survey Bulletin 2004, p. 19.

Cox, D.P., and Bagby, W.C., 1986, Descriptive model of W veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p.64.

Cox, D.P., and Singer, D.A., 1986, Mineral deposit models: U.S. Geological Survey Bulletin 1693, 379 p.

Cox, D.P., and Singer, D.A., 1992, Grade and tonnage model of distal disseminated Ag-Au, *in* Bliss, J.D., ed., Developments in mineral deposit modeling: U.S. Geological Survey Bulletin 2004, p. 20-22.

Cox, D.P., and Theodore, T.G., 1986, Descriptive model of copper skarn deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 86.

Cox, L.J., Chaffee, Cox, D.P., and Klein, D.P., Porphyry Cu deposits, *in* Du Bray, ed., Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models: U.S. Geological Survey Open-File Report 95-831, p. 75-89.

Da Rosa, J.D., and Lyon, J.S., 1997, Golden dreams, poisoned streams: Washington, D.C., Mineral Policy Center, 269 p.

Dorr, J.V.N., II, Crittenden, M.D., Jr., and Worl, R.G., 1973, Manganese, *in* Brobst, D.A., and Pratt, W.P., eds., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 385-399.

Einaudi, M.T., Meinert, L.D., and Newberry, R.J., 1981,Skarn deposits, *in* B.J. Skinner, ed., Economic Geology Seventy-Fifth Anniversary Volume, The Economic Geology Publishing Co., p. 317-391.

Fankhauser, R.E., 1969, Geology and mineralization of the southern Cuddy Mountains, Washington County, Idaho: M.S. Thesis, Oregon State University, 174 p.

Fifarek, R.G., Juhas, A.P., and Field, C.W., 1994, Geology, mineralization, and alteration of the Red Ledge volcanogenic massive sulfide deposit, western Idaho, *in* Vallier, T.L., and Brooks, H.C., eds., Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: Stratigraphy, physiography, and mineral resources of the Blue Mountains Region: U.S. Geological survey Professional Paper 1439, p. 113-150.

Fisher, F.S., and Johnson, K.M., eds., 1995a, Geology and mineral resource assessment of the Challis 1^o x 2^o quadrangle, Idaho: U.S. Geological Survey Professional Paper 1525.

Fisher, F.S., and Johnson, K.M., 1995b, Challis volcanic terrane, *in* Fisher, F.S. and Johnson, K.M., eds., Geology and Mineral Resource Assessment of the Challis 1^o x 2^o Quadrangle, Idaho: U.S. Geological Survey Professional Paper 1525, p. 135-137.

Fitzgerald, J.F., 1982, Geology and basalt stratigraphy of the Weiser Embayment, west-central Idaho, *in* Bonnichsen, B., and Breckenridge, R.M., eds., Cenozoic geology of Idaho: Idaho Bureau of Mines and Geology, Bulletin 26, p. 103-128.

Forrester, J.D., 1940, Geological report on the Golden Anchor Mining Company property: Golden Anchor Mining Co. report, 24 p.

Frost, T.P., Raines, G.L., Almquist, C.L., and Johnson, B.R., 1996, Digital maps of possible bat habitats for the Pacific Northwest: a contribution to the Interior Columbia Basin Ecosystem Management Project: U.S. Geological Survey Open-File Report 95-683, 20 p.

Gammons, C.H., 1988, Studies in hydrothermal phenomena: (2) A paragenesis and fluid inclusion study of polymetallic vein mineralization in the Big Creek mining district, central Idaho: Ph.D. thesis, the Pennsylvania State University, Department of Geosciences, p. 100-271.

Goldfarb, R.J., Berger, B.R., Klein, T.L., Pickthorn, W.J., and Klein, D.P., 1995, Low sulfide Au quartz veins, in Du Bray, E.A., ed., Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models: U.S. Geological Survey Open-File Report 95-831, p. 261-267.

Green, W.R., 1972, Delineation of mineral belts of northern and central Idaho: Idaho Bureau of Mines and Geology Information Circular No. 22, 8 p.

Gualtieri, J.L., 1973, Arsenic, *in.* Brobst, D.A. and Pratt, W.P., eds., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 51-61.

Hammarstrom, J.M., Kotlyar, B.B., Theodore, T.G., Elliott, J.E., John, D.A., Doebrich, J.L., Nash, J.T., Carlson, R.R., Lee, G.K., Livo, K.E., and Klein, D.P., 1995, Cu, Au, and Zn-Pb skarn deposits, in Du Bray, E.A., ed., Preliminary compilation of descriptive geoenvironmental mineral deposits models: U.S. Geological Survey Open-File Report 95-831, p. 90-111.

Hammarstrom, J.M., Zientek, M.L., Elliott, J.E., Van Gosen, R.R., Carlson, R.R., Lee, G.K., and Kulik, D.M., 1993, Mineral resource assessment for locatable minerals (exclusive of the Stillwater Complex), Chapter G, *in* Hammarstrom, J.M., Zientek, M.L., and Elliott, J.E., eds., Mineral resource assessment of the Absaroka-Beartooth study area, Custer and Gallatin National Forests, Montana: U.S. Geological Survey Open-File Report 93-207, p. G1 to G78.

Harris, D.P., 1984, Mineral resource appraisal: Oxford, Clarendon Press, 445 p.

Hausel, W.D., 1995, Diamonds and their host rocks in the United States: Mining Engineering, v. 47, no. 8, p. 723-732.

Hendricksen, T.A., 1975, Geology and mineral deposits of the Mineral-Iron Mountain district, Washington County, Idaho, and of a metallized zone in western Idaho and Eastern Oregon: Oregon State University Ph.D. thesis, 202 p.

Hopkins, R.T., Jr., Motooka, J.M., McHugh, J.B., Watts, K.C., King, H.D., and Barton, H.N., 1996, Geochemical data from the Payette National Forest and contiguous areas, Idaho: U.S. Geological Survey Open-File Report 96-535, 6 p., 1 diskette.

John, D.A., and Bliss, J.D., 1994, Grade and tonnage model of tungsten skarn deposits, Nevada: U.S. Geological Survey Open-File Report 94-005, 35 p.

Johnson, K.M., and Fisher, F.S., 1995, Precious-metal deposits hosted by high-level rhyolites, *in* Fisher, F.S. and Johnson, K.M., eds., Geology and Mineral Resource Assessment of the Challis 1^{o} x 2^{o} Quadrangle, Idaho: U.S. Geological Survey Professional Paper 1525, p. 135-137.

Jones, G.M., and Menzie, W.D., 1986a, Grade and tonnage model of Cu skarn deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 86-89.

Jones, G.M., and Menzie, W.D., 1986b, Grade and tonnage model of W veins: *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 65-66.

Jorgensen, D.B., 1994, Gypsum and anhydrite, *in* Carr, D.D., ed., Industrial Minerals and Rocks, 6th Edition: Society for Mining, Metallurgy, and Exploration, Inc., Littleton, Colorado, p. 571-581.

Kiilsgaard, T.H., 1995, Pegmatites containing piezoelectric quartz crystals, *in* Fisher, F.S. and Johnson, K.M., 1995, Geology and mineral resource assessment of the Challis 1^{o} x 2^{o} Quadrangle, Idaho: U.S. Geological Survey Professional Paper 1525, p. 141.

Kiilsgaard, T.H., and Hall, W.E., 1995, Radioactive black-sand placer deposits, *in* Fisher, F.S. and Johnson, K.M., 1995, Geology and mineral resource assessment of the Challis 1^{o} x 2^{o} Quadrangle, Idaho: U.S. Geological Survey Professional Paper 1525, p. 183-189.

Kirwin, Brian, and Hubbard, S.M., 1984, Geology of the Venable claim group, Thunder Mountain mining district, Valley County, Idaho: unpublished report to Coeur Mining Co., 16 p.

Kirkham, R.V., 1995, Volcanic redbed copper (type 9), *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian Mineral Deposit Types:

Geological Survey of Canada, Geology of Canada, no. 8, p. 241-252 (*also* Geological Society of America, The Geology of North America, v. P-1).

Kirkham, R.V., and Sinclair, W.D., 1996, Porphyry copper, gold, molybdenum, tungsten, tin, silver, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian Mineral Deposit Types: Geological Survey of Canada, Geology of Canada, no. 8, p. 421-446 (*also* Geological Society of America, The Geology of North America, v. P-1).

Kirkham, V.R.D., 1931, Revision of the Payette and Idaho Formations: Journal of Geology, v. 34, no. 3, p. 193-239.

Kirkpatrick, G.E., 1975, Geology and ore deposits of the Big Creek Area, Idaho and Valley Counties, Idaho: M.S. thesis, University of Idaho, Moscow, Idaho, 60 p.

Lambeth, R.G., and Iverson, S.R., 1987, Mineral resource assessment of the Bold Ruler site-specific study area, Thunder Mountain district, Frank Church - River of No Return Wilderness, Valley County, Idaho: U.S. Department of the Interior, Bureau of Mines, Mineral Land Assessment Open-File Report MLA 12-87, 70 p.

Langer, W.H., 1988, Natural aggregates of the conterminous United States: U.S. Geological Survey Bulletin 1594, 33 p.

Leonard, B.F., 1965, Mercury-bearing antimony deposit between Big Creek and Yellow Pine, central Idaho: U.S. Geological Survey Prof. Paper 525-B, p. B23-B28.

Leonard, B.F., 1973, Gold anomaly in soil of the West End Creek area, Yellow Pine district, Valley County, Idaho: U.S. Geological Survey Circular 680, 16 p.

Leonard, B.F., 1980, Deep exploration target at Red Mountain stockwork, Yellow Pine, Idaho: *in* Geological Survey Research 1980: U.S. Geological Survey Professional Paper 1175, p. 12-13.

Leonard, B.F., and Erdman, J.A., 1983, Preliminary report on geology, geochemical exploration, and biogeochemical exploration of the Red mountain stockwork, Yellow Pine district, Valley County, Idaho: U.S. Geological Survey Open-File Report 83-151, 49 p.

Leonard, B.F., and Marvin, R.F., 1982, Temporal evolution of the Thunder Mountain Caldera and related features, central Idaho: *in* W. Bonnichsen, and R.M. Breckenridge, eds., Cenozoic Geology of Idaho: Idaho Bureau of Mines and Geology Bulletin 26, p. 23-41.

Leonard, B.F., Mead, C.W., and Conklin, Nancy, 1967, Silver-rich disseminated sulfides from a tungsten-bearing quartz lode, Big Creek district, central Idaho: U.S. Geological Survey Prof. Paper 594, p. C1-C24.

Lesure, F.G., 1973, Mica, *in.* Brobst, D.A. and Pratt, W.P., eds., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 415-423.

Lewis, R.D., 1984, Geochemical investigations of the Yellow Pine, Idaho, and Republic, Washington mining districts: West Lafayette, Indiana, Purdue University, Ph.D. thesis, 204 p.

Lewis, R.S., Kiilsgaard, T.H., Bennett, E.H., and Hall, W.E., 1987, Lithologic and chemical characteristics of the central and southeastern part of the southern lobe of the Idaho Batholith, *in* Vallier, T.L., and Brooks, H.C., eds., Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: The Idaho Batholith and its border zone: U.S. Geological Survey Professional Paper 1436, p. 171-196.

Livingston, D.C., 1919, Tungsten, cinnabar, manganese, molybdenum, and tin deposits of Idaho, with notes on the antimony deposits by Francis A. Thompson: University of Idaho School of Mines Bulletin 2, 67 p.

Livingston, D.C., 1923, A geologic reconnaissance of the Mineral and Cuddy mountain mining district, Washington and Adams Counties, Idaho: Idaho Bureau of Mines and Geology, Pamphlet 13, 24 p.

Livingston, D.C. and Laney, F.B., 1920, The copper deposits of the Seven Devils and adjacent districts (including Heath, Hornet Creek, Hoodoo, and Deer Creek): Idaho Bureau of Mines and Geology Bulletin 1, 105 p.

Lorain, S.H., and Metzger, O.H., 1938, Reconnaissance of placer mining districts in Idaho County, Idaho: United States Department of the Interior, Bureau of Mines Information Circular 7023, 93 p.
Ludington, S., Orris, G.J., and Cox, D.P., 1992, Methods of resource assessment: in U.S. Geological Survey and Servicio Geologico de Bolivia, Geology and mineral resources of the Altiplano and Cordillera Occidental, Bolivia: U.S. Geological Survey Bulletin 1975, p. 218-219.
Mackin, J.H., 1953, Iron-ore deposits of the Iron Mountain district, Washington County, Idaho: U.S. Geological Survey Bulletin 982-E, p. 121-151.
Mangham, J.R., 1994, Geology of the Peck Mountain massive sulfide prospect, Adams county, Idaho, *in* Vallier, T.L., and Brooks, H.C., eds., Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: Stratigraphy, physiography, and mineral resources of the Blue Mountains Region: U.S. Geological survey Professional Paper 1439, p. 101-111.
May, T.P., 1984, The geology of a portion of the Marshal Lake district, Idaho County, Idaho: M.S. thesis, University of Idaho, Moscow, Idaho, 101 p.
McDivitt, J.F., 1952, A report on gypsum deposits in Washington County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 93, 15 p.
Meinert, L.D., 1993, Skarns and skarn deposits: *in* Sheahan, P.M., and Cherry, M.E., eds., Ore deposit models, volume II: Geological Association of Canada, Geoscience Canada, Reprint Series 6, p. 117-134.
Menzie, W.D., and Jones, G.M., 1986, Grade and tonnage model of W skarn deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 55-57.
Menzie, W.D., and Singer, D.A., 1990, A course on mineral resource assessment: *in* Proceedings of the International Symposium on Mineral Exploration: The use of artificial intelligence: Tokyo and Tsukuba, Japan, Mining and Materials Processing Institute of Japan, p. 177-188.
Menzie, W.D., and Singer, D.A., 1993, Grade and tonnage model of porphyry Cu deposits in British Columbia, Canada, and Alaska, U.S.A: U.S. Geological Survey Open-File Report 93-0275, 9 p.
Michalski, T.C., and Modreski, P.J., 1991, Descriptive model of diamond bearing kimberlite pipes (model 12), in Orris, G.J., and Bliss, J.D., eds., Some Industrial Mineral Deposit Models: Descriptive Deposit Models: U.S. Geological Survey Open-File Report 91-11A, p. 1-4.
Miller, M.H., 1973, Antimony, *in.* Brobst, D.A. and Pratt, W.P., eds., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 45-50.
Mitchell, R.H., 1993, Kimberlites and lamproites: Primary sources of diamond, in Sheahan, P.A., and Cherry, M.E., Ore Deposit Models, Vol. II, Geological Association of Canada, Geoscience Canada reprint series 6, p. 13-28.
Mitchell, V.E., 1995, History of the Stibnite mining area, Valley County, Idaho: Idaho Geological Survey Special Report, 166 p.
Morganti, J.M., 1972, Geology and ore deposits of the Seven Devils volcanics, Seven Devils mining district, Hell's Canyon, Idaho: Pullman Washington, Washington State University, M.S. thesis, 153 p.
Mosier, D.L., 1986, Grade and tonnage model of sedimentary Mn, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 231-233.
Mosier, D.L., Berger, B.R., and Singer, D.A., 1986, Descriptive model of Sado epithermal veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 154.
Mosier, D.L., and Campbell, D.L., 1995, Epithermal Mn deposits, in Du Bray, E.A., ed., Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models: U.S. Geological Survey Open-File Report 95-931, p. 170-173.

Mosier, D.L., and Menzie, W.D., 1986, Grade and tonnage model of Fe skarn deposits, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 94-97.

Mosier, D.L., and Page, N.J., 1988, Descriptive and grade-tonnage models of volcanogenic manganese deposits in oceanic environments--a modification: U.S. Geological Survey Bulletin 1811, 28 p.

Mosier, D.L., and Sato, Takeo, 1986, Grade and tonnage model of Sado epithermal veins, *in* Cox, D.P. and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 155-157.

Mosier, D.L., Berger, B.R., and Singer, D.A., 1986, Descriptive model of Sado epithermal veins, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 154.

Mottana, Annibale, Crespi, Rodolfo, and Liborio, Giuseppe, 1978, Simon and Schuster's guide to rocks and minerals: translated from Italian to English by Catherine Athill, Hugh Young and Simon Pleasance; Martin Prinz, George Harlow and Joseph Peters eds., Simon and Schuster, New York, 607 p.

Murray, S.A., 1979, The Marshal Lake mines: Their history and development: M.A. thesis, University of Idaho, Moscow, Idaho, 97 p.

Nakai, T.S., 1979, Stratigraphy of the Payette Formation, Washington County, Idaho: Moscow, Idaho, University of Idaho M.S. thesis, 116 p.

Orris, G.J., 1986a, Descriptive model of bedded barite (model 31b), *in* Cox, D.P. and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 216.

Orris, G.J., 1986b, Grade and tonnage model of bedded barite (model 31b), *in* Cox, D.P. and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 216-218.

Orris, G.J., 1992a, Grade and tonnage model of bedded barite (model 31b), *in* Orris, G.J., and Bliss, J.D., Industrial Minerals Deposit Models: Grade and tonnage models: U.S. Geological Survey Open-File Report 92-437, p. 40-42.

Orris, G.J., 1992b, Preliminary grade and tonnage model of barite veins (model 27e), *in* Orris, G.J., and Bliss, J.D., Industrial Minerals Deposit Models: Grade and tonnage models: U.S. Geological Survey Open-File Report 92-437, p. 32-34.

Orris, G.J., 1992c, Grade and tonnage model of fluorite veins (model 26b), *in* Orris, G.J., and Bliss, J.D., Industrial Minerals Deposit Models: Grade and tonnage models: U.S. Geological Survey Open-File Report 92-437, p. 29-31.

Orris, GJ., 1993d, Preliminary grade and tonnage model of marine bedded gypsum (model 35a.5), *in* Orris, G.J., and Bliss, J.D., Industrial Minerals Deposit Models: Grade and tonnage models: U.S. Geological Survey Open-File Report 92-437, p. 53-55.

Orris, G.J., 1993e, Preliminary grade and tonnage model of lacustrine gypsum (model 35b.9), *in* Orris, G.J., and Bliss, J.D., Industrial Minerals Deposit Models: Grade and tonnage models: U.S. Geological Survey Open-File Report 92-437, p. 60-62.

Orris, G.J., and Bliss, J.D., 1985, Geologic and grade-volume data on 330 gold placer deposits: U.S. Geological Survey Open-File Report 85-213, 172 p.

Orris, G.J., and Bliss, J.D., 1986, Grade and tonnage model of placer Au-PGE, *in* Cox, D.P. and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 261-264.

Orris, G.J., Bliss, J.D., Hammarstrom, J.M., and Theodore, T.G., 1987, Description and grade and tonnages of gold-bearing skarns: U.S. Geological Survey Open-File Report 87-273, 50 p.

Parsley, P.G., 1997, Geology and ore mineralization of the Dewey deposit, Thunder Mountain mining district, Valley County, Idaho [abs]: Pacific Northwest Metals and Minerals Conference, Columbia Section, Society for Mining, Metallurgy, and Exploration, Inc., April 23-25, Spokane, Washington, p. 13.

Payette National Forest Newsletter, 1996, NEPA scoping document, Stibnite mine expansion project, 1996 Draft Environmental Impact Statement Revision and Final Environmental Impact Statement: May 9, 1996, 6 p.
Petkoff, Benjamin, 1970, Mica, *in* Mineral Facts and Problems: U.S. Bureau of Mines Bulletin 650, p. 1083-1098.
Prinz, W.C., 1964, Manganese, *in* Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report 1, p. 116-119.
Pruitt, R.G., Jr., 1981, Digest of mining claim laws, second edition: Rocky Mountain Mineral Law Foundation, Boulder, Colorado, 207 p.
Raines, G.L., Johnson, B.R., Frost, T.P., and Zientek, M.L., 1996, Digital maps of compositionally classified lithologies derived from 1:500,000 scale geologic mapping for the Pacific Northwest: a contribution to the Interior Columbia Basin Ecosystem Management Project: U.S. Geological Survey Open-File Report 95-685, 28 p.
Randol mining directory: Randol International Ltd., Golden Colorado (biannual).
Raup, O.B., Descriptive model of bedded gypsum (model 35ae), *in* Orris, G.J. and Bliss, J.D., Some Industrial Deposit Models: Descriptive Deposit Models: U.S. Geological Survey Open-File Report 91-11A, p. 34-35.
Reed, J.C., 1937, Geology and ore deposits of the Warren mining district, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet No. 45, 65 p.
Ridenour, James, 1985, Overview of mineral occurrences in the Frank Church - River of No Return Wilderness and surrounding region, central Idaho: U.S. Department of the Interior, Bureau of Mines Mineral Land Assessment Open File Report MLA 64-85, 211 p.
Root, D.H., Menzie, W.G., and Scott, W.A., 1992, Computer Monte Carlo simulation in quantitative resource estimation: Nonrenewable Resources, v. 1, no. 1, p. 125-138.
Ross, C.P., 1936, Mining districts of the state of Idaho: Idaho Bureau of Mines and Geology in cooperation with U.S. Department of the Interior, Geological Survey (1:500,000 scale).
Rytuba, J.J., 1986a, Descriptive model of hot-spring Hg, *in* Cox, D.P. and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 178.
Rytuba, J.J., 1986b, Grade and tonnage model of hot-spring Hg, *in* Cox, D.P. and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 178-179.
Rytuba, J.J. and Kleinkopf, M.D., 1995, Silica-carbonate Hg deposits, *in* Du Bray, ed., Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models: U.S. Geological Survey Open-File Report 95-831, p. 199-203.
Savage, C.N., 1961, Economic geology of central Idaho blacksand placers: Idaho Bureau of Mines and Geology Bulletin 17, 159 p.
Schrader, F.C., and Ross, C.P., 1926, Antimony and quicksilver deposits in the Yellow Pine district, Idaho, *in* Loughlin, G.F. and Mansfield, G.R., eds., Contributions to Economic Geology, 1925: U.S. Geological Survey Bulletin 780, p. 137-165.
Seal, R.R., II, Bliss, J.D., and Campbell, D.L., Stibnite-quartz deposits, *in* Du Bray, ed., Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models: U.S. Geological Survey Open-File Report 95-831, p. 204-208.
Shannon, E.V., 1926, The minerals of Idaho: Smithsonian Institution, United States National Museum Bulletin 131, 483 p.
Shannon, S.S., and Reynolds, S.J., 1975, A brief geological survey of the East Thunder Mountain mining district, Valley County, Idaho: Idaho Geological Survey Information Circular 29, 13 p.
Shenon, P.J., and Ross, C.P., 1936, Geology and ore deposits near Edwardsburg and Thunder Mountain, Idaho: Idaho Bureau of Mines and Geology Pamphlet No. 44, 45 p.

Singer, D.A., 1993, Basic concepts in three-part quantitative assessment of undiscovered mineral resources: Nonrenewable Resources, p. 69-81.
Singer, D.A., 1995, World class base and precious metal deposits -- A quantitative analysis: Economic Geology, v. 90, p. 88-104.
Singer, D.A., 1986, Descriptive model of Kuroko massive sulfide: *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 189-190.
Singer, D.A., 1992a, Some basic concepts in three-part quantitative assessment of undiscovered mineral resources: ISME '92, International Symposium on Mineral Exploration, Tokyo University, September 1992, Abstracts.
Singer, D.A., 1992b, Grade and tonnage of Sierran Kuroko deposits, *in* Bliss, James D., ed., Developments in mineral deposit modeling: U.S. Geological Survey Bulletin 2004, p. 29-32.
Singer, D.A., and Cox, D.P., 1987, Applications of mineral deposit models to mineral resource assessments: U.S. Geological Survey Yearbook Fiscal year 1987, p. 55-57.
Singer, D.A., and Mosier, D.L., 1986, Grade and tonnage model of Kuroko massive sulfide, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 190-197.
Singer, D.A., Cox, D.P., and Mosier, D.L., 1986, Grade and tonnage model of porphyry Cu-Mo, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 116-119.
Singer, D.A., Mosier, D.L., and Cox, D.P., 1986, Grade and tonnage model of porphyry Cu, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 77-81..
Smitherman, J.R., 1988, Geologic map of the Stibnite roof pendant, Valley County, Idaho: Idaho Geological Survey Technical Report 88-2.
Stoll, W.C., 1950, Mica and beryl pegmatites in Idaho and Montana: U.S. Geological survey Professional Paper 229, 64 p.
Taylor, C.D., Zierenberg, R.A., Goldfarb, R.J., Kilburn, J.E., Seal, R.R. II, and Kleinkopf, M.D., 1995, Volcanic-associated massive sulfide deposits, *in* Du Bray, ed., Preliminary Compilation of Descriptive Geoenvironmental Mineral Deposit Models: U.S. Geological Survey Open-File Report 95-831, p. 137-144.
Theodore, T.G., Orris, G.J., Hammarstrom, J.M., and Bliss, J.D., 1991, Gold-bearing skarns: U.S. Geological Survey Bulletin 1930, 61 p.
Turner, H.W., 1908, The ore deposits at Mineral, Idaho: Economic Geology, v. 39, no. 6, p. 492-502.
Umpleby, J.B., and Livingston, D.C., 1920, A reconnaissance in south central Idaho, embracing the Thunder Mountain, Big Creek, Stanley Basin, Sheep Mountain, and Seafoam districts: Idaho Bureau of Mines and Geology Bulletin 3, 23 p.
USBLM (U.S. Bureau of Land Management), undated, Placer examination, principles and practice: U.S. Department of the Interior Bureau of Land Management Technical Bulletin 4 (reprinted with permission and for sale by Alaskan Prospectors Publishing, Fairbanks, Alaska.), 209 p.
USBM (U.S. Bureau of Mines) and USGS (U.S. Geological Survey), 1980, Principles of a resource/reserve classification for minerals, a revision of the classification system published as U.S. Geological Survey Bulletin 1450-A: U.S. Geological Survey Circular 831, 5p.
USBM (U.S. Bureau of Mines), staff of Western Field Operations Center, 1996, Administrative summary report description of mines and prospects in the Payette National Forest, Idaho: MLA OFR 1-96, 56 p., 2 appendices, 1 pl., 4 figs.
USDA Forest Service, 1994, Stibnite mine expansion project: Draft Environmental Impact Statement: Payette National Forest, Krassel Ranger District, McCall, Idaho, 325 p., 7 appendices.

USFS (U.S. Forest Service), 1983, Anatomy of a mine from prospect to production: USDA Forest Service General Technical Report INT-35, Revised July, 1983, 69 p.
USFS (U.S. Forest Service), 1994, A guide to your National Forests: U.S. Department of Agriculture, Forest Service map FS-418.
USFS (U.S. Forest Service), 1995a, Payette National Forest: Weiser, Council, and New Meadows Ranger Districts: Forest Visitor/Travel Map (1:126,720 scale).
USFS (U.S. Forest Service), 1995b, Payette National Forest: McCall and Krassel Ranger Districts: Forest Visitor/Travel Map (1:126,720 scale).
USMX, Inc., 1997, Initial plan of operations for the USMX, Inc. Thunder Mountain project, Dewey mine: Proposal submitted to Krassel Ranger District, Payette National Forest, and Idaho State Department of Lands, 48 p., 42 appendices.
Vallier, T.L., 1977, The Permian and Triassic Seven Devils Group, western Idaho and northeastern Oregon: U.S. Geological Survey Bulletin 1437, 58 p.
Vallier, T.L., and Brooks, H.C., eds., 1994, Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: Stratigraphy, physiography, and mineral resources of the Blue Mountains Region: U.S. Geological survey Professional Paper 1439, 198 p.
Weis, P.L., Schmitt, L.J., Jr., and Tucheck, E.T., 1972, Mineral resources of the Salmon River Breaks Primitive Area, Idaho: U.S. Geological Survey Bulletin 1353-C, 91 p.
Williams, G.A., 1964, Gems and gem materials, *in* Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report 1, p. 91-93.
Wood, G.H, and Bour, W.V., III, 1988, Coal map of North America, U.S. Geological Survey map (1:5,000,000 scale) and report, 44 p.
Yeend, W.E., 1986, Descriptive model of placer Au-PGE, *in* Cox, D.P., and Singer, D.A., eds., Mineral deposit models: U.S. Geological Survey Bulletin 1693, p. 261.
Zientek, M.L., Bookstrom, A.A., Box, S.E., and Johnson, B.R., 1996, Future minerals related activity, Interior Columbia Basin Ecosystem Management Project area: an overview: U.S. Geological Survey Open-File Report 95-687, 30 p.

Appendix A.
Mineral localities in PNF and vicinity, sorted alphabetically
(by name, with location, commodities, deposit-type codes, and references)

Deposit Code	Deposit Type
001	Gold-silver Mixed-metal Veins
002	Distal Disseminated Gold-silver
003	Antimony Veins
004	Tungsten Veins -- Quartz-scheelite
005	Tungsten Veins -- Quartz-huebnerite
007	Low-sulfide Gold-quartz Veins
009	Polymetallic Layers and Veins
010	Copper-silver Polymetallic Veins
011	Manganese Layers and Veins
012	Barite Layers and Veins
013	Porphyry Copper-molybdenum
014	Copper Skarn
015	Iron Skarn
016	Disseminated Copper-silver
017	Kuroko Zinc-copper massive sulfide
018	Hot-spring Gold-silver
019	Hot-spring Mercury
020	Opal
021	Quartz -- Pegmatite, Vein
022	Mica -- Pegmatite
023	Gypsum and Anhydrite
024	Gold Placer
025	Black-sand Placer
026	Rare-earth Placer
027	Tungsten Skarn
029	Rare-earth Lode
030	Gold Skarn
031	Disseminated Antimony
032	Zinc-lead Skarn
033	Copper-gold Mixed-metal Veins
034	Copper-silver-gold Pegmatite
035	Quartz-fluorite Veins
038	Magmatic Iron-Copper
044	Unclassified
046	Uranium, unclassified
047	Gem Placer
049	Diamond Pipes
050	Ag-Au Polymetallic Veins

Deposit codes for types of mineral deposits in PNF and vicinity

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
1	1905 Mine	45 5 33.45 N	116 42 35.66 W	Cu	016			2
2	Abundance Mine	44 34 00 N	117 00 41 W	Fe, Cu	015			114, 35
3	Acorn Butte No. 1 Occurrence	45 11 12 N	115 04 50 W	Au, Ag, Cu	033			79
4	Acorn Butte No. 2 Occurrence	45 11 7.27 N	115 4 35.76 W	Au, Ag	033			79
5	Acorn Butte No. 3 Prospect	45 10 31 N	115 05 05 W	Au, Cu, Ag	033			79
6	Acorn Butte No. 4 Occurrence	45 10 22 N	115 05 42 W	Au, Cu, Ag	033			79
7	Acorn Group Prospect	45 09 47 N	115 06 10 W	Au, Ag	033			79
8	Advance Prospect	44 56 08 N	115 12 04 W	Au, Ag	018			79
9	Alaska Mine	45 8 .53 N	116 38 48.08 W	Cu, Mo, W	014			11, 2, 92
10	Alberta Mine	45 24 02	115 48 46	Au, Ag	001			
11	Allison Creek Occurrence	45 07 41 N	116 42 25 W	Cu	016			17
12	Allison Ranch Placer Mine	45 33 56.33 N	115 13 12.10 W	Au, monazite	024	025	026	65
13	Ann Nos. 1 And 2 Prospect	45 22 4.18 N	115 20 21.76 W	Au, Ag, Pb, Zn	001			79
14	Antimony Bar No. 1 Prospect	45 20 12 N	115 44 21 W	Sb	003			1
15	Antimony Rainbow Group Mines	45 8 21.29 N	115 24 5.39 W	W, Cu, Sb, Au, Ag	001	005	002	99, 101, 89
16	Antimony Ridge Mine	44 56 5.31 N	115 27 33.33 W	Sb, Ag, Au	003	031		108, 113
17	Antz Creek Prospect	45 2 35.77 N	116 48 20.82 W	Cu, Zn	010	016		13
18	Arkansaw Mine	45 07 33 N	116 37 33 W	Cu	014			11, 2
19	Arlise Gulch Placer Mine	45 14 53 N	115 42 47 W	Au	024	025		66
20	Arlise Vein Mine	45 15 10 N	115 43 19 W	Au	001			66
21	Azurite Mine	45 2 35.73 N	116 47 20.70 W	Cu, Pb, Zn	010			11, 2
22	Azurite Prospect	44 33 39.13 N	117 3 23.81 W	Cu, Zn	001			61, 37
23	B And B No. 4 Prospect	45 3 45.06 N	115 24 27.61 W	Hg, Sb, Ag	003	001		101
24	B. J. Occurrence	45 12 32.46 N	115 14 40.51 W	Au	033			79
26	Badger Mine	45 06 49 N	116 39 56 W	Cu, Ag, Au	016			2
25	Badger Prospect	45 13 .59 N	115 16 6.81 W	Au	033			79
27	Ballard Group Mine	45 03 14 N	116 48 46 W	Cu	010	016		4, 13
28	Banner Mine	45 28 58.12 N	116 2 3.00 W	Au, Ag	001			94, 92
29	Bargamin Bar Placer Mine	45 34 3.75 N	115 11 31.71 W	Au, monazite	024	025	026	65
30	Barite Occurrence	45 05 37 N	115 07 23 W	Ba	012			79
31	Barth Hot Springs Bar Placer Occurrence	45 30 44.45 N	115 2 33.48 W	Au	024	025		79
32	Bear Creek Bar Placer Mine	45 31 14.68 N	115 5 15.71 W	Au, monazite	024	025	026	79, 65
33	Bear Track Mine	45 13 .09 N	115 40 3.53 W	Au	001			78
34	Bear Trap Occurrence	45 04 58 N	115 01 27 W	opal	020			79
35	Beaver Creek Basin Placer Prospect	45 13 45 N	115 17 53 W	Au	024	025		79
36	Beaver Creek Placer Prospect	45 09 49 N	115 14 30 W	Au	024	025		79
37	Bell Mine	44 33 35.02 N	117 3 36.54 W	Ag, Ag	009			61, 56, 37, 38, 74
38	Belmont Mine	44 45 14.15 N	116 51 14.70 W	Ag, Zn, Pb	009			47, 48, 56, 84
39	Benson Occurrence	45 14 00 N	115 33 00 W	Mo	014	001		32

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map					Deposit Codes*			
no.	Mineral Locality	Latitude	Longitude	Commodity	dc1	dc2	dc3	References
40	Betty Jane Claim Occurrence	45 12 43.29 N	115 12 32.86 W	Ag, Cu	033			79
41	Big 4 Occurrence	45 12 32.24 N	115 19 25.62 W	Au, Ag	001			79
42	Big Buck Prospect	44 56 30 N	115 09 20 W	Au, Ag	018			79
43	Big Chief Claims Occurrence	44 49 43.66 N	115 19 42.94 W	Ag, Au, Cu, Pb	013	001		79
44	Big Creek Gold Mines Placer Prospect	45 5 53.96 N	115 19 41.01 W	Au	024	025		69
45	Big Duluth Prospect	44 57 48 N	115 11 17 W	Au	018			79
46	Big Horn Prospect	45 02 44 N	114 43 42 W	Au, Ag, Cu	033			79
47	Big Mallard Bar Placer Mine	45 32 8.58 N	115 16 14.41 W	Au, monazite	024	025	026	65
48	Big Ramey Placer Occurrence	45 10 36.60 N	115 9 43.04 W	Au	024	025		79
49	Big Squaw Creek Fluorspar Prospect	45 28 59 N	114 58 03 W	F	035			65
50	Big Sunflower No. 1 Prospect	45 10 41.14 N	115 9 33.95 W	Cu, Au, Ag	033			79
51	Bill Timm Prospect	44 56 58 N	115 09 10 W	Au, Ag	018			79
52	Black and White Claim Prospect	45 10 41.97 N	115 9 22.57 W	Cu, Au, Ag	033			79
53	Black Bear Prospect	45 29 34.62 N	116 3 47.62 W	Au	001			94
54	Black Diamond Mine	45 31 52.12 N	115 27 4.96 W	Au	001			80, 81
55	Black Hawk Mine	44 33 39.32 N	117 4 6.15 W	Ag, Cu	009			61, 37, 56
56	Black Jack Prospect	44 33 19.94 N	117 3 25.95 W	Ag, Cu	009			61
57	Black Lake Mine	45 11 21.82 N	116 33 9.06 W	Au	007			2
58	Black Sand Creek Placer Mine	45 29 22.14 N	116 2 6.97 W	Au	024			94
59	Black Swan Prospect	45 11 31.69 N	115 20 29.02 W	Au, Ag	001			79
60	Blanche E Prospect	44 57 25 N	115 05 58 W	Au, Ag	018			79
61	Blossom Mine	45 30 34.66 N	116 2 1.85 W	Au	001			94, 92
62	Blue Bluff Prospect	45 9 33.94 N	115 22 56.95 W	Cu	001			99
63	Blue Jacket Mine	45 7 35.85 N	116 38 26.85 W	Cu, Ag, Au	014			2
64	Blue Stone Prospect	45 11 25.96 N	115 20 29.16 W	Au, Ag	001			79, 99
65	Bluebird Prospect	44 57 40 N	115 09 31 W	Au, Ag	018			79
66	Boise Bar Placer Mine	45 26 25.97 N	115 26 35.55 W	Au, monazite	024	025	026	65
67	Boise Creek Prospect	45 26 35.40 N	115 26 40.46 W	feldspar, Au	034			65
68	Bold Ruler Prospect	44 57 20 N	115 04 59 W	Au, Ag	018			79
70	Bonanza Placer Occurrence	44 52 24 N	115 03 49 W	Au	024	025		79
69	Bonanza Prospect	44 56 35.05 N	115 19 .61 W	Au, Ag	002			108
71	Boone Mine	44 34 1.02 N	117 4 16.83 W	Ag, Cu	009			61, 56
72	Bostic Occurrence	45 12 12 N	115 59 26 W	Hg, Sb	019			68
74	Boulder Creek Occurrence	44 55 32 N	115 13 25 W	Au	018			79
73	Boulder Creek Placer Occurrence	45 14 31.01 N	115 18 43.58 W	Au	024			79
75	Box Springs Claim Prospect	45 9 47.83 N	115 5 8.67 W	Cu, Au, Ag	033			79
76	Broken Hill Pit (proposed mine)	44 55 28.03 N	115 18 38.04 W	Au, Ag	002			137, 138, 139
77	Brooklyn Group Prospect	45 10 20 N	116 44 16 W	Cu, Ag, Au	010			4, 8
78	Brown Bear Occurrence	45 10 09 N	115 05 28 W	Ag, Au, Cu	033			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map					Deposit Codes*			
no.	Mineral Locality	Latitude	Longitude	Commodity	dc1	dc2	dc3	References
79	Brownlee Manganese Prospect	44 46 53.24 N	116 52 18.88 W	Mn	011			11
80	Bruin Creek Bar Placer Occurrence	45 31 2.61 N	115 4 21.13 W	Au	024	025		79
81	Buck Placer Mine	45 20 37 N	115 42 48 W	Au	024	025		66
82	Bucks Bed Prospect	44 54 30 N	115 16 52 W	Hg	019			109, 32
83	Buffalo Group Prospect	44 54 14.08 N	115 13 14.71 W	Au	018			79
84	Bullion Lode Silver Mine	45 27 43.26 N	115 57 41.57 W	Ag, Au	001			94, 95, 104
85	Bullion Prospect	44 56 45 N	115 08 45 W	Au, Ag	018			79
86	Burnt Rock Occurrence	44 52 47 N	116 19 44 W	Mn	011			54
87	Burris Placer Mine	45 05 30 N	115 07 40 W	Au	024	025		79
88	Buttercup Group Placer Mine	45 30 21 N	116 00 24 W	Au, peat	024			94
89	Cabin Creek Bar Placer Occurrence	45 7 41.59 N	114 56 18.67 W	Au	024	025		79
90	California Prospect	45 09 01 N	116 37 29 W	Cu	014			2
91	Calumet Prospect	45 07 37 N	116 37 52 W	Cu	014			2
92	Camp Bird No. 1 Occurrence	45 07 00 N	115 21 00 W	Au, Ag	001			
93	Campbell Magnetite Mine	44 33 38.03 N	117 0 51.56 W	Fe, Cu	015			64, 35, 85, 36
94	Cap. Miller Mine	45 03 26 N	116 48 34 W	Cu	010	016		4
95	Carbonate Hill Area Prospect	45 15 1.45 N	116 34 11.10 W	Au	007			11
96	Carpenters Gulch Placer Occurrence	45 10 08 N	115 08 11 W	Au	024	025		79
97	Carrick Diggings Placer Mine	45 06 54 N	116 33 41 W	Au	024			11
98	Catherine Lake Prospect	45 1 51.75 N	115 16 5.28 W	Au, Ag	018			79
99	Cave Creek Placer Occurrence	45 08 55 N	114 57 12 W	Au	024	025		79
100	Century Prospect	44 55 8.58 N	115 11 15.46 W	Au, Ag	018			79
101	Chamberlain Meadow Placer Prospect	45 22 20.05 N	115 11 10.93 W	Au, REE	024	025	026	79
102	Charity Gulch Placer Mine	45 14 28 N	115 39 58 W	Au, Th?	024	026		66
103	Charity Mine	45 14 46.38 N	115 40 26.34 W	Au	001	004		66, 102, 96, 92
104	Cheapman - Wanderer Prospect	44 59 30 N	115 07 50 W	Au, Ag	018			79
105	Chief Executive Group Occurrence	44 50 28 N	115 05 59 W	Au	018			79
106	Churchill Creek Occurrence	45 31 39.87 N	115 18 24.33 W	Ag	034			65
107	Cinnamid Pit (proposed mine)	44 55 .86 N	115 18 5.15 W	Au, Ag	002	030		137, 138, 139
108	Clark Occurrences	45 01 01 N	116 13 56 W	mica	022			22
109	Cleveland Mine	45 4 2.68 N	115 26 54.42 W	Ag	001			69, 75, 76
110	Cliff Prospect	45 14 40.40 N	116 39 39.48 W	Cu, Ag, Au	010			18, 11, 2
111	Climax Prospect	44 44 4.56 N	116 48 38.45 W	Cu, Ag	015			47, 56
112	Climax Prospect	44 56 29 N	115 08 59 W	Au	018			79
113	Cold Meadows Placer Occurrence	45 17 01 N	114 56 41 W	Au	024	025		79
114	Cole Occurrence	45 03 06 N	116 49 20 W	Cu	010	016		4
115	Combination Mine	45 2 16.95 N	115 24 58.43 W	Pb, Ag, Zn	001	032	005	69, 74
116	Con Dor Mine	44 33 48.19 N	117 3 30.35 W		009			36, 37, 61
117	Consolidation Occurrence	44 59 37 N	115 06 20 W	Au	018			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
118	Coone Creek Occurrence	44 56 53.74 N	115 9 19.21 W	Ag, Au	018			79
119	Copper Camp Flat Placer Occurrence	45 10 23.58 N	115 11 20.06 W	Au	024	025		79
120	Copper Camp Prospect	45 10 43.89 N	115 11 51.69 W	Cu, Au, Ag	033	024		69, 79, 89
121	Copper Clad Group Prospect	45 05 52 N	115 07 51 W	Cu	033			79
123	Copper Cliff Mine	45 6 7.58 N	116 40 26.52 W	Cu, Ag	016			17, 59, 18, 23, 119
122	Copper Cliff Occurrence	45 1 .52 N	115 21 14.95 W	Cu	014			69
124	Copper Creek Placer Occurrence	45 10 27.97 N	115 13 6.84 W	Au	024	025		79
125	Copper King Prospect	44 56 31 N	115 28 58 W	Au, Ag, Cu, Sb	001			108
126	Copper Mountain Prospect	44 50 .73 N	115 20 12.93 W	Cu, W, Ag	014	027		79
127	Copper Occurrence	45 6 4.48 N	116 44 10.42 W	Cu	016			17
128	Copper Prospect	45 7 6.11 N	115 9 9.47 W	Cu	033			69
129	Cory Bar Placer Mine	45 29 38.82 N	114 59 6.57 W	Au, monazite	024	025	026	65
130	Cottonwood Butte Prospect	45 18 12.42 N	114 45 52.71 W	Ag	001	050		79
131	Cougar Creek Placer Occurrence	45 6 12.88 N	114 49 14.98 W	Au	024	025		79
132	Coxey Creek Bar Placer Occurrence	45 8 20.39 N	115 1 56.58 W	Au	024	025		79
133	Coxey Creek Placer Occurrence	45 9 35.93 N	115 1 15.51 W	Au	024	025		79
134	Cracker Jack Prospect	45 03 06 N	116 46 00 W	Cu	010			
135	Crane Meadows Placer Prospect	45 17 12.78 N	115 17 45.35 W	Au	024	025	026	79
136	Crest Prospect	45 12 .65 N	115 20 52.69 W	Au	001			79
137	Crooked Creek Placer Occurrence	45 11 51.49 N	115 5 20.46 W	Au	024	025		79
138	Crossing Bar Placer Occurrence	45 9 53.93 N	115 12 59.26 W	Au	024	025		79
139	Crystal Mountain Quartz Quarry Mine	45 17 22 N	115 53 30 W	quartz	021			
140	Cuddy Mine	44 48 39.61 N	116 43 56.19 W	Au	044			48
141	Culver Creek Placer Occurrence	44 46 40 N	115 51 40 W	Au	024			79
142	Cumberland Prospect	44 57 41 N	115 09 55 W	Au, Ag	018			79
143	Curren Mtn. Prospect	45 12 20 N	116 31 07 W	Au,Ag	007			
144	D. D. Prospect	45 10 30.34 N	115 21 1.42 W	Au	001			79
145	Dagnapan Prospect	45 10 17.90 N	115 16 9.17 W	Au, Ag	001	002		79
146	Daisy Prospect	45 24 50.11 N	115 51 57.30 W	Au	001			78
147	Daylight And Darkness Placer Prospect	44 52 38 N	115 03 50 W	Au	024	025		79
148	Deckie Prospect	45 01 52 N	114 44 03 W	Au, Ag, Cu	033			79
149	Deer Creek Prospect	45 05 34 N	115 06 19 W	Cu	033			79
150	Deer Ridge Occurrence	45 25 47 N	116 10 25 W	sheet mica	022			22, 26
151	Delaware Mine	45 14 52.84 N	115 42 20.79 W	Au	001			66, 78
152	Dennett Creek Prospect	44 33 59.47 N	117 2 40.99 W	Au, Cu	001			61
153	Dewey Mine	44 57 33.97 N	115 8 43.29 W	Au, Ag	018			79, 69, 19, 110, 130
154	Dewey Moore Group Prospect	45 9 4.32 N	115 5 10.45 W	Au, Ag	033			79
155	Dewey Vein Prospect	45 14 42.82 N	115 43 22.98 W	Au	001			66
156	Diamond Creek Occurrence	45 09 18 N	115 09 38 W	Au	033			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
157	Dillinger Meadows Placer Occurrence	45 29 46.35 N	115 11 18.81 W	Au	024	025		79
158	Disappointment Bar Placer Occurrence	45 25 21.20 N	114 52 46.14 W	Au	024	025		79
159	Dixie Comstock Mine	45 31 .03 N	115 27 4.15 W	Au, Pb	001			78, 80, 82
160	Dixie Mine	45 07 09 N	115 24 09 W	Au, Ag, W	001	002		69, 70
161	Doctor Prospect	44 55 20 N	115 12 27 W	Au	018			79
162	Dodger Placer North Occurrence	45 21 41 N	115 31 12 W	Au, Ti, Fe	024	025		79
163	Dodger Placer South Occurrence	45 21 36 N	115 31 12 W	Au	024	025		79
164	Dokka Mine	45 08 07 N	115 22 58 W	Sb	003			
165	Doris K Pit (proposed mine)	44 54 50.08 N	115 18 35.33 W	Au, Ag	002	030		137, 138, 139
166	Doris K Prospect	44 53 50 N	115 18 35 W	Sb	003	031		108, 109
167	Douglass Prospect	45 9 35.57 N	116 39 23.40 W	Cu	014			2
168	Dove Creek Prospect	45 08 30 N	116 44 44 W	Cu	010			7
169	Dovel Placer Mine	45 03 55 N	115 06 58 W	Au	024	025		79
170	Duches N. Claim Occurrence	44 49 20 N	115 20 30 W	Au, Ag	044			79
171	Duerden Prospect	45 20 22.92 N	115 54 34.88 W	Au, Pb, Zn, Ag	001			78, 87
172	Dynamite Placer Occurrence	44 52 14.00 N	115 6 28.79 W	Au	024	025		79
173	Dynamite Prospect Occurrence	45 12 33.72 N	115 19 51.27 W	Au	001			79
174	Eagan Mine	44 34 3.56 N	117 4 25.17 W	Ag, Cu	009			61, 39, 56
175	Eagle Occurrence	45 20 00 N	115 12 50 W	Ag	034			79
176	East Brownlee Creek Prospect	44 45 11.71 N	116 48 36.26 W	Cu	038			47
177	East Fork of Mann Creek Occurrence	44 35 44 N	116 56 40 W	Cu	016			53
178	Eckels Creek Stock Occurrence	45 05 51 N	116 42 41 W	Cu, Zn	016			17
179	Edna May Prospect	44 48 14.69 N	116 45 56.94 W	Pb, Cu	009			11, 55
180	Elkhorn Bar Placer Mine	45 26 55.64 N	114 55 15.14 W	Au, monazite	024	025	026	65
181	Elkhorn Prospect	45 29 30 N	116 03 34 W	Au	001			94
182	Emly Mine	45 15 06 N	115 43 14 W	Au, Ag	001			78
183	Enterprise Mine	44 34 2.10 N	117 4 15.58 W	Ag, Cu	009			61
184	Ethal B. Occurrence	44 56 40 N	115 07 30 W	Au, Ag	018			79
185	Eureka Occurrence	44 53 30.96 N	115 14 51.15 W	Au	018			79
186	Evenstone Occurrence	44 58 31 N	115 05 48 W	Au, Ag	018			79
187	Excelsior Bar Placer Occurrence	45 24 41.42 N	115 28 9.76 W	Au	024	025		79
188	Fall Creek Placer Occurrence	45 10 15.23 N	115 10 51.58 W	Au	024	025		79
189	Farrell Group Occurrence	45 01 37 N	116 51 10 W	Cu	010	001		4
190	Fern Mine	44 54 24.70 N	115 16 59.76 W	Hg	019			46, 111, 135
191	Fisher And Baumhoff Placer Mine	45 17 11.24 N	115 41 51.94 W	Au	024			21
192	Florence "A" Group Prospect	45 12 35 N	115 15 10 W	Au, Ag	033			79
193	Four V Occurrence	44 43 01 N	116 49 24 W	Cu, Au, Ag	044			51
194	Fourth of July Mine	45 7 26.65 N	115 21 45.31 W	Au, Ag	001			
195	Freeze Prospect	44 48 47 N	116 44 06 W	Au	007			56, 130

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
196	French Creek Placer Mine	45 25 24.94 N	116 1 36.47 W	Au	024			21
197	Frenchy's Mine	45 5 42.39 N	116 37 41.42 W	Cu, Au, Mo	044			2
198	Gabbro Occurrence	44 37 05 N	116 56 18 W	Cu	038			53
199	Gaines Bar Placer Mine	45 28 24.11 N	115 23 32.09 W	Au, garnet, monazite	024	025	026	65
200	Galena Central Prospect	45 2 6.13 N	115 23 23.96 W	Pb, Zn, Cu, W, Ag, Au	001	032		1
201	Galena Prospect	45 11 19 N	115 04 17 W	Pb, Cu, Au, Ag	033	001		79
202	Garnet Creek Pit Mine	44 54 25.05 N	115 18 54.42 W	Au, Ag	002	030		137, 138, 139
203	Garnet Creek Prospect	44 54 32.97 N	115 18 54.46 W	Au, Ag	002	027	031	109, 116
204	Gayety Placer Mine	45 13 49.35 N	115 40 12.35 W	Au	024			66
205	Gayety Vein Prospect	45 13 58.64 N	115 39 59.91 W	Au	001			66
206	Gayhart Burns Placer Mine	45 14 21 N	115 48 29 W	Au	024			88
207	Giant Legge Group Occurrence	44 52 28 N	115 12 02 W	Au, Ag	018			79
208	Gilt Edge Prospect	45 30 17.15 N	116 1 8.83 W	Au	001			94
209	Glasgow Prospect	45 3 13.67 N	115 24 59.37 W	Au	001			72, 73
210	Glasgow-Green Occurrence	45 8 28.12 N	116 38 23.41 W	Cu	014			2
211	Goat Creek Placer Occurrence	45 6 46.91 N	114 48 17.23 W	Au	024	025		79
212	Goat Haven Group Prospect	45 06 40 N	115 09 38 W	Cu, Au, Ag	033			79
213	Gold Bug Cabin Prospect	45 13 5.96 N	115 15 34.11 W	Au, Ag	033			79
214	Gold Bug Mine	45 28 41.86 N	116 2 15.24 W	Au	001			94, 92
215	Gold Bug No. 5 Claim Prospect	45 12 31.13 N	115 11 45.63 W	Au, Ag, Cu	033			79
216	Gold Cord Group Prospect	44 51 15 N	115 05 02 W	Au, Ag	018			79
217	Gold Crown Group Prospect	45 12 18.86 N	115 15 8.59 W	Au, Ag, Cu	033			79
218	Gold Dike Prospect	44 55 55 N	115 09 35 W	Ag	018			79
219	Gold Dollar Group Prospect	45 13 33 N	115 10 21 W	Au, Cu	033			79
220	Gold Dust Sonny Placer Mine	45 31 45.20 N	115 18 13.09 W	Au, monazite	024	025		65
221	Gold Fork Placer Prospect	44 42 1.82 N	116 1 32.65 W	Ti	025			50
222	Gold Hill Group Occurrence	45 10 38.10 N	115 22 10.32 W	Au	024			79
223	Gold King Mine	45 13 37.19 N	115 36 54.65 W	Au, Ag	001			78
224	Gold Lodge Claim Prospect	45 08 17 N	115 00 47 W	Au, Ag	018			79
225	Gold Nugget Prospect	44 55 46 N	115 08 53 W	Ag	018			79
226	Gold Occurrence	44 38 26.01 N	116 58 28.00 W	Au	007			53
227	Gold Reef Group Prospect	45 12 55.22 N	115 15 25.73 W	Au, Ag, Cu	033			79
228	Gold Rock #2 Prospect	45 14 36.07 N	115 37 58.03 W	Au	001			
229	Gold Run Mine	45 21 31.80 N	115 50 49.56 W	Au	001			78
230	Gold Slide Group Prospect	45 13 1.97 N	115 15 30.54 W	Au, Ag	033			79
231	Golden Anchor Mine	45 24 28.10 N	115 51 45.60 W	Au, Ag	001			78
232	Golden Bear Claims Prospect	45 10 47 N	115 07 42 W	Cu, Au, Ag	033			79
233	Golden Chimney Prospect	44 56 58 N	115 10 17 W	Au, Ag	018			79
234	Golden Coin Group Prospect	44 56 17.34 N	115 9 10.29 W	Ag, Au	018			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
235	Golden Cup Prospect	45 8 57.96 N	115 20 46.25 W	Cu, Au	001	002		99, 70
236	Golden Gate Prospect	44 56 31 N	115 29 21 W	Au, Ag, Sb	001	031		108, 89
237	Golden Gate Tungsten Mine	44 57 12.16 N	115 28 54.22 W	W	004	002		
238	Golden Giant Prospect	44 56 21 N	115 09 30 W	Au	018			79
239	Golden Hand Mine	45 13 21.52 N	115 19 14.46 W	Au, Ag	001	002		69, 79, 99
240	Golden Rule Placer Mine	44 51 20 N	115 02 30 W	Au, Th, Ti, REE	024	025	026	79, 105
241	Golden Rule Placer Mine	45 16 42.09 N	115 49 45.36 W	Au, Ag	024			88, 21
242	Golden Way Up Mine	45 6 42.20 N	115 25 13.44 W	Au	001	002		69, 70
243	Golden West Mine	45 07 47 N	115 23 56 W	Sb, W, Au	001	003	002	101, 70
244	Goldfield Group Occurrence	45 12 43.24 N	115 14 42.19 W	Au, Ag, REE, Ti	033			79
245	Golzones Claim Group Prospect	44 49 9.26 N	116 44 40.20 W		044			
246	Goodenough Mine	45 15 18.51 N	115 40 56.39 W	Au, Ag	001			66, 84, 42, 92
247	Goodenough Prospect	44 48 2.35 N	116 0 34.31 W	quartz	021			1
248	Goodrich Creek Canyon Prospect	44 42 52 N	116 36 49 W	Cu	014			45
249	Grade Creek Prospect	44 46 28.03 N	116 50 1.77 W	Pb, Ag, Zn, Cu	009			47, 49, 56
250	Grandview Claims Prospect	45 14 56.77 N	115 38 44.15 W	Au	001			66
251	Granite Queen Prospect	44 43 41 N	116 16 03 W	Cu	014			1
252	Grassy Flat Placer Occurrence	45 02 15 N	114 43 31 W	Au	024	025		79
253	Grays Peak Opal Prospect	44 49 56 N	115 04 24 W	opal	020			79
254	Green Goode Occurrence	44 55 16 N	115 13 23 W	Au	018			79
255	Green Jacket Prospect	45 6 5.01 N	115 8 8.28 W	Cu, Au, Ag	033			79
256	Green Spider Prospect	45 7 59.44 N	115 21 2.83 W	Sb, Cu	001	002		99
257	Groundhog Bar Placer Mine	45 28 43.65 N	115 20 56.63 W	Au, monazite	024	025		65, 79
258	Grouse Creek Placer Occurrence	45 28 55.07 N	116 0 1.15 W	U	025			14
260	Gypsum Mine	44 34 9.19 N	117 2 14.68 W	gypsum	023			30
259	Gypsum Occurrence	44 34 2.96 N	117 4 52.96 W	gypsum	023			33, 56
261	H - Y Prospect	44 56 55 N	115 08 30 W	Au, Ag	018			69, 79
262	H. T. Abstein's Prospect	44 54 17 N	115 16 50 W	Hg	019			32
263	Halls Gulch Placer Mine	45 15 17.78 N	115 42 31.40 W	Au	024			66
264	Hamilton - Hillsman Claim Prospect	45 23 58 N	115 10 41 W	Ag, Au, Cu	034			79
265	Hand Meadows Placer Prospect	45 16 50.53 N	115 15 52.39 W	Au	024	025	026	79
266	Happy Jack Prospect	45 12 55.99 N	115 16 2.31 W	Au, Cu	033			79
267	Hard Boil Bar Placer Occurrence	45 8 32.45 N	115 3 47.60 W	Au	024	025		79
268	Harris - Holte Mine	45 24 2.59 N	115 50 49.88 W	Au	001			78, 85
269	Haypress Meadow Placer Prospect	45 17 24.56 N	115 10 31.04 W	Au, REE	024	025	026	79
270	Healy Creek Placer Mine	45 29 41.95 N	116 2 33.81 W	Au	024			94
271	Helena Mine	45 7 34.41 N	116 38 19.16 W	Cu, Au, Ag, Mo, W	014			11, 2
272	Hen Creek Prospect	45 20 10 N	115 24 07 W	Ag	001			79
273	Hennessey Prospect	44 54 36.62 N	115 17 28.44 W	Hg, Sb	019	003		32, 59

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
275	Hercules Group Prospect	44 45 54.84 N	116 51 36.58 W	Au, Ag, Cu, Pb, Zn	009			59, 56, 57
274	Hercules Group Prospect	44 56 29.48 N	115 12 8.65 W	Au, Ag	018			79
276	Hercules Prospect	45 12 57.45 N	115 19 52.35 W	Au	001			79
277	Hermes Mine	44 55 6.83 N	115 17 22.46 W	Hg	019			46, 111
278	Hermit Hanks Bar Placer Occurrence	45 32 07 N	115 17 31 W	Au	024	025		79
279	Hermit Hanks Prospect	45 31 43 N	115 18 04 W		001	050		79
280	Hi Yu Mine	45 29 3.31 N	116 2 22.38 W	Au	001			94, 92
281	Hidden Fawn Occurrence	45 25 58.04 N	116 10 15.28 W	sheet mica, scrap mica	022			22
282	Highland Claim Occurrence	44 57 30 N	115 03 40 W	Au, Ag	018			79
283	Hill Claims Occurrence	45 4 8.44 N	116 48 1.26 W	Cu	010			4
284	Hillside Prospect	45 10 11 N	115 18 13 W	Au	044			79
285	Hilltop Occurrence	45 12 48 N	115 21 30 W	Au	001			79
286	Hinkson - Bishop Mine	45 24 28.32 N	115 50 9.57 W	Au, Ag	001			78
287	Hold Out Occurrence	44 55 24 N	115 08 53 W	Ag	018			79
288	Hollenbeat Quartz Occurrence	45 22 19 N	116 18 19 W	silica	021			12
289	Hollister Prospect	45 10 25.86 N	115 17 22.32 W	Au	001			79
290	Holmadge Prospect	45 28 47 N	116 03 22 W	Au	001			94
291	Homestake Pit Mine	44 55 57.57 N	115 19 45.35 W	Au, Ag	002			92
292	Hoodoo Creek Placer Mine	45 15 40.97 N	115 43 48.85 W	Au	024	025		66
293	Hope Claim Occurrence	44 51 42 N	115 06 33 W	Au, Ag	018			79
294	Hornet Creek Prospect	44 52 41.35 N	116 35 34.64 W	Cu, Au, Ag	017			2, 56
295	Hornet Vein Prospect	45 15 3.22 N	115 42 25.52 W	Au	001			66
296	Horse Creek and Horse Bar Placer Mines	45 24 5.21 N	114 44 5.71 W	Au, Fe, garnet, monazite, Ti, Zr	024	025	026	65
297	Horse Mountain Occurrence	45 07 02 N	116 39 33 W	Cu	016			17
298	Houlahan Prospect	44 46 19 N	116 51 35 W	Pb	009			56
299	Huddleson Placer Occurrence	45 21 16 N	115 31 04 W	Au	024	025		79
300	Humboldt Prospect	45 08 43 N	116 37 53 W	Cu	014			2
301	Huntz Gulch Bar Placer Occurrence	45 27 27.43 N	115 56 11.68 W	Au, monazite, garnet	024	025	026	
302	Hurricane Eagle Prospect	44 56 50 N	115 08 30 W	Au, Ag	018			79
303	Hyatt Prospect	45 22 48.50 N	115 49 13.91 W	Au	001			78
304	Ibex Claim Occurrence	44 53 59 N	115 09 40 W	Au, Ag	018			79
305	Idaho - Rainbow Group Prospect	45 11 50.12 N	115 4 43.75 W	Cu, Au	033	001		79
306	Idaho Klondike Placer Mine	45 20 05 N	115 48 43 W	Au	024			21
307	Imnaha Occurrence	45 19 01 N	116 41 15 W	Au	007			4
308	Imperial Prospect	45 19 35 N	115 10 54 W	Au, Ag	001	050		79
309	Independence Prospect	45 9 14.45 N	115 23 32.10 W	Au, Ag	001	002		69, 99, 43, 76, 67
310	Independence Prospect	44 53 47 N	115 15 13 W	Au	018			79
311	Inspiration Barite Occurrence	44 52 22 N	116 34 42 W	Ba	012			1
312	Iola Mine	45 13 33 N	115 39 45 W	Au, Ag	001			66, 92

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map					Deposit Codes*			
no.	Mineral Locality	Latitude	Longitude	Commodity	dc1	dc2	dc3	References
313	Iron Dyke Mine	45 1 32058 N	116 51 21.82 W	Cu,Au,Ag	017			3,4,5,13
314	Iron Prospect	44 43 52.56 N	116 48 10.14 W	Cu, Fe	015			47, 48
315	IXL Mine	44 44 26.07 N	116 46 57.47 W	Cu, Mo, Au, Ag	013			58, 11, 48, 59, 56, 2
316	J. G. Hill Occurrence	44 36 52 N	117 06 17 W	Mn	011			32
317	Jacobs Occurrence	44 51 14 N	115 48 37 W	silica	021			12
318	Jensen Group Mine	45 11 25 N	115 03 00 W	Cu, Au, Ag	033			69
319	Jerico Claim Occurrence	44 51 40 N	115 15 19 W	Au, Cu, Mo	013	001		79
320	Jerome Group Occurrence	44 51 40 N	115 05 45 W	Au, Ag	018			79
321	Joe Deposit Prospect	45 14 28 N	115 18 33 W	Au, Ag	033			72
322	John Vine Bar Placer Occurrence	45 7 57.06 N	114 59 39.77 W	Au	024	025		79
323	Johnson Lode Prospect	45 02 45 N	114 39 22 W	Au, Ag, Cu	033			79
324	Julie Creek Bar Placer Occurrence	45 31 56.08 N	115 16 58.69 W	Au	024	025		79
325	July Blizzard Prospect	45 12 31.11 N	115 20 12.16 W	Au	001			79
326	Jumbo Prospect	44 57 40 N	115 07 45 W	Au, Ag	018			79
327	Juno Prospect	45 24 27.32 N	115 48 3.63 W	Au	001			78
328	Kennedy Prospects	44 56 33.64 N	115 18 57.55 W	Au, Sb	002	003		109
329	Ketchum Claim Occurrence	44 58 07 N	115 02 40 W	silica	020			79
330	Keystone Meadows Placer Prospect	45 13 35.51 N	115 41 41.08 W	Au	024	025		66
331	Kimmel Creek Prospect	45 4 15.78 N	114 45 48.78 W	Au, Ag, Cu	033			79
332	King Prospect	44 33 36.13 N	117 3 43.94 W	Ag, Cu	009			61, 37
333	Kingfish Occurrence	45 13 41 N	115 36 32 W	Au	001			78
334	Kismet Prospect	44 48 5.29 N	116 41 24.00 W	Cu, Mo, Pb, Zn, Ag, Au	013			48
335	Knott Mine	45 14 48.28 N	115 42 27.25 W	Au	001			66, 78, 92
336	Koger Group Occurrence	45 02 50 N	116 51 37 W	Cu	010	016		4
337	L. S. No. 1 Claim Prospect	44 58 25 N	115 02 55 W	Au, Ag	018			79
338	Ladwick Group Occurrence	45 05 48 N	115 24 36 W	Au	001			72
339	Lake Creek Placer Mine	45 19 39.17 N	115 56 30.54 W	Au	024			88, 21
340	Lakeside Prospect	45 8 46.87 N	115 21 6.04 W	Au, W	001			79, 99
341	Lantz Bar Placer Mine	45 25 8.17 N	114 52 5.46 W	Au, monazite	024	025	026	65
342	Lark Occurrence	44 55 34 N	115 09 02 W	Ag	018			79
343	Larsen Mine Prospect	45 15 17.31 N	115 39 26.55 W	Au	001			
345	Last Chance Claim Prospect	45 18 36 N	115 41 24 W	Au	001			66
344	Last Chance Claim Prospect	45 10 59.55 N	115 15 3.69 W	Au, Ag	033			79
346	Lead Zone Mine	44 49 6.27 N	116 45 32.75 W	Pb, Ag, Zn, Au	009			11, 48, 55
347	Lemhi Bar Placer Occurrence	45 28 33.37 N	115 23 12.25 W	Au	024	025		79
348	Lewiston Fraction Claim Occurrence	45 13 18.06 N	115 15 37.74 W	Ag, Cu, Au	033			79
350	Liberty Mine	44 34 6.47 N	117 4 25.36 W	Ag, Cu	009			61
349	Liberty Prospect	45 27 42.18 N	115 59 31.56 W	Au	001			94
351	Lily Of The Valley Placer Mine	45 29 18.60 N	116 1 7.01 W	Au	024			94

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
352	Lime Creek Prospect	45 10 35 N	115 03 34 W	Au, Ag	033			79
353	Lime Peak Prospect	45 4 54.04 N	116 46 20.02 W	Cu	010	016		11
354	Linton Mine	45 13 42.71 N	115 40 39.64 W	Au	001	024		66
355	Lion Prospect	44 58 15 N	115 09 00 W	Au, Ag	018			79
356	Little Cottonwood Creek Prospect	44 55 25 N	115 03 15 W	Au, Ag	018			79
357	Little Cow Creek Placer Mine	45 28 32 N	116 03 07 W	Au	024			94
358	Little Gem No. 7 Mine	45 12 32.22 N	115 15 27.99 W	Au, Ag, Cu, Pb, Zn, Mo	033			79
359	Little Giant Mine	45 15 30.50 N	115 40 58.14 W	Au, Ag	001	004	005	66, 96, 98, 32, 92
360	Little Joe Occurrence	44 55 30 N	115 09 05 W	Ag	018			79
361	Little Marble Creek Placer Prospect	45 05 00 N	115 16 19 W	Au	024	025		79
362	Little Ramey Placer Occurrence	45 10 29 N	115 08 49 W	Au	024	025		79
363	Little Sheepeater Prospect	45 23 45 N	115 23 52 W	Ag, Au	001			79
364	Lockwood Mine	45 08 19 N	116 39 10 W	Cu, Ag, W, Mo	014			11, 2
365	Lodgepole Meadow Placer Prospect	45 19 .41 N	115 12 7.48 W	REE	026	025		79
366	Logan Copper Hill Prospect	45 7 10.64 N	115 23 19.80 W	Sb, Cu	003	014		101, 99
367	Lost Meadows And Bitterroot Placer Mine	45 28 58 N	116 02 34 W	Au	024			94
368	Lost Packer Prospect	45 12 43.94 N	115 20 40.19 W	Au, Cu, Sb, Zn	001			79, 99
369	Lotspiech Prospect	45 2 29.06 N	115 24 10.98 W	Au?	001			
370	Lower Iron Clad Claims Prospect	45 5 52.86 N	115 6 40.07 W	Cu, Au, Ag	033			79, 69
371	Lower Kimmel Creek Prospect	45 4 6.37 N	114 43 45.16 W	Au, Ag, Cu	033			79
372	Lower Ramey Meadows Placer Occurrence	45 16 11.91 N	115 11 27.96 W	REE	026	025		79
373	Lower Survey Creek Prospect	45 3 28.27 N	114 43 34.34 W	Au, Ag, Cu	033			79
374	Lucky Ben Mine	45 15 13.89 N	115 43 12.31 W	Au	001			66
376	Lucky Boy Occurrence	45 12 14.89 N	115 21 21.61 W	Au	001			79
375	Lucky Boy Placer Occurrence	44 52 29.30 N	115 14 36.28 W	Au, Ag	024			79
377	Lucky Strike Prospect	45 08 03 N	116 37 20 W	Cu, Ag	010			2
378	Ludwig Prospect	45 7 40.59 N	115 24 21.87 W	Au, Ag, W	001	002	004	43, 96, 99, 72
379	Luzon Claim Occurrence	45 13 22.32 N	115 15 48.91 W	Au, Cu	033			79
380	Lynes Occurrence	45 5 14.64 N	116 44 9.91 W	Cu	016			17
381	Mac Dougall Group Prospect	45 4 42.20 N	116 47 54.90 W	Cu	010	016		4
382	Madam Queen Prospect	44 56 33 N	115 19 39 W	Au	002	003		109
383	Mahan Prospect	45 12 43.52 N	115 15 58.99 W	Au, Cu, Ag	033			79
384	Mammoth Prospect	45 27 39.14 N	115 29 57.39 W	Au, Pb, Zn, Cu	001	002		104, 80, 78, 81
385	Mann Creek Occurrence	45 06 18 N	116 40 51 W	Cu, Zn	016			17
386	Marble Creek Placer Prospect	44 56 34.06 N	115 6 13.00 W	Au	024	025		79
387	Marble Creek Prospect	45 04 37 N	115 16 30 W	Au, Ag, Ni, Pb	033			79
388	Mariah Mine	44 33 47.29 N	117 4 14.75 W	Ag, Cu, Au	009			61, 74, 38, 37, 56
389	Martinace Meadows Placer Prospect	45 13 45.96 N	115 42 25.83 W	Au	024			66, 21
390	Marygold Property	45 27 30 N	115 54 00 W	W	004			1

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
391	Mayflower Mine	45 14 40.65 N	115 38 27.55 W	Au	001			
392	Mc Carty Mine	45 0 56.48 N	116 50 26.48 W	Zn, Cu, Pb, Au, Ag	017			11, 13
393	Mc Curkle - Shane Mine	44 33 56.59 N	117 3 48.43 W	Ag, Cu	009			114, 56, 74
394	Mc Govern And Hackney Placer Mine	45 17 19 N	115 42 11 W	Au	024			66
395	Mc Rae Mine	45 9 46.84 N	115 24 14.78 W	W	005	004		102, 99, 89
396	Meadow Creek Mine	44 54 1.45 N	115 19 58.39 W	Au, Ag, Sb	001			69, 116, 109
397	Meadow Creek Placer Mine	45 30 45.43 N	116 0 18.74 W	Au	024			94
398	Merrill and Vance Prospect	45 13 8.37 N	115 14 41.34 W	Au	033			72
399	Metheny Prospect	44 45 44.08 N	116 50 28.52 W	Cu	015			56
400	Meyers Creek Placer Occurrence	45 34 7.84 N	115 13 3.70 W	Au	024	025		79
401	Mica Queen Mine	44 39 8.05 N	116 14 51.08 W	sheet mica, feldspar, flake mica	022			26, 22, 62
402	Midnight Pit Mine	44 55 35.64 N	115 19 26.97 W	Au, Ag	002			
403	Mile Flat Placer Occurrence	45 8 44.23 N	115 5 38.03 W	Au	024	025		79
404	Milk Lake Prospect Occurrence	45 03 03 N	115 05 05 W	Au, Ag	018			79
405	Minerva Group Prospect	44 58 17 N	115 09 20 W	Ag	018			79
406	Minnehaha Vein Prospect	45 14 1.04 N	115 42 21.32 W	Ag, Au	001			66, 78
407	Missouri Creek Group Prospect	45 00 54 N	115 22 00 W	Cu	014			69
408	Mohawk Vein Occurrence	45 14 11 N	115 42 25 W	Au	001			66, 78
409	Mollie Prospect	44 56 23 N	115 08 45 W	Au	018			79
410	Monday Prospect	44 55 28.76 N	115 20 4.29 W	Au, Sb	002	001		109, 116
411	Monitor Vein Prospect	45 14 14 N	115 42 25 W	Au	001			66, 78
412	Montana Prospect	44 33 27.41 N	117 1 7.97 W	Fe, Cu	015			85, 35
413	Monument Occurrence	45 3 36.20 N	115 7 15.19 W	opal	020			79
414	Monumental Bar Placer Occurrence	45 9 40.49 N	115 7 47.14 W	Au	024	025		79
415	Monumental Creek Ranch Placer Mine	45 1 .59 N	115 7 12.33 W	Au	024	025		79
416	Monumental Summit Rare-earth Prospect	44 54 8.42 N	115 15 51.07 W	Ce, Y, REE, Mn	029			79, 128
417	Moore Bar Placer Mine	45 29 12.67 N	115 20 8.15 W	Au, monazite	024	025	026	65
418	Moose Meadow Placer Occurrence	45 18 42 N	115 07 02 W	REE	026	025		79
419	Morning Occurrence	44 55 36 N	115 08 51 W	Ag	018			79
420	Morning Star Tungsten Claims Prospect	45 09 24 N	115 23 49 W	W	005	001	002	1
421	Mortimer Prospect	44 32 8.81 N	117 1 47.21 W	Fe, Cu	015			85, 35
422	Moscow Mine	45 6 .94 N	115 24 15.24 W	Au	001	002		69, 72, 73
423	Mother Lode Prospect	45 12 23.25 N	115 14 54.76 W	Au, Ag, Cu	033			79
424	Mountain Chief Prospect	44 54 02 N	115 17 15 W	Hg, Sb	019			109
425	Mountain Sheep Placer Occurrence	45 21 00 N	115 30 55 W	Au	024	025		79
426	Mountain View Placer Occurrence	44 52 02 N	115 02 45 W	Au	024	025		79
427	Mt. Marshall Prospect	45 23 35.71 N	115 51 45.10 W	Au	001			78, 84
428	Mule Creek Prospect	44 58 01 N	115 09 59 W	Au, Ag	018			79
429	Mule Train Claims Occurrence	44 52 09 N	115 16 45 W	Au, Ag, Cu, Pb, W	044			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map					Deposit Codes*			
no.	Mineral Locality	Latitude	Longitude	Commodity	dc1	dc2	dc3	References
430	Mulligan Group Prospect	45 11 42 N	115 15 45 W	Au, Ag	001			79
431	Murphy Peak Prospect	44 53 06 N	115 14 35 W	Au, Ag	018			79
432	Name Unknown Prospect	44 38 53 N	117 08 03 W	Au, Ag	007			28
433	Nat Lode Prospect	45 9 4.89 N	115 8 27.74 W	Cu, Ag, Au	033			79
434	Nelly More Occurrence	45 13 1.02 N	115 19 21.38 W	Au, Ag	001			79
435	Nethken Prospect	44 56 7.41 N	115 19 43.92 W	Sb, Au	002	003		109
436	New Hope Mine	44 58 20 N	115 04 10 W	Au, Ag	018			79, 106
437	New Meadows Manganese Occurrence	44 55 15 N	116 19 11 W	Mn	011			1
438	Nice Boy Occurrence	44 58 36 N	115 13 46 W	Au	018			79
439	Nixon Bar Placer Mine	45 30 36.87 N	115 3 44.93 W	Au, monazite	024	025	026	65
440	No Name Claim Occurrence	45 9 30.90 N	115 3 45.75 W		033			79
441	No Name Placer Occurrence	45 08 10 N	115 01 26 W	Au	024	025		79
443	North Fork Occurrence	44 56 35 N	115 08 20 W	Ag	018			79
442	North Fork Of West Fork Occurrence	45 01 41 N	115 13 10 W	Au, Ag	018			79
444	North Hornet Mine (Peck Mountain prospect)	44 53 14.49 N	116 38 27.93 W	Au, Ba	012			11
445	North Monday Occurrence	44 55 29.61 N	115 20 2.02 W	Au, Hg	002	019		109
446	North Tunnel Prospect	44 54 58.99 N	115 20 14.65 W	Au, Sb	002	001		109
447	Nugget Creek Placer Occurrence	45 12 37 N	114 41 06 W	Au	024	025		79
448	O'Leary's Prospect	45 09 24 N	116 37 15 W	Cu	014			2
449	O. K. Occurrence	45 21 23 N	116 14 02 W	sheet mica	022			22
450	Oberbillig Prospect	44 57 15.29 N	115 28 51.88 W	W	027			16
451	Old Johnson Lode Prospect	45 03 14 N	114 38 58 W	Au, Ag, Cu	033			79
452	Old Kentuck Prospect	45 24 40.96 N	115 51 32.96 W	Au	001			78
453	Olson's Placer Mine	44 38 27 N	117 06 19 W	Au, Ag	024			28
454	Orofino Group Mine	45 12 15 N	115 14 57 W	Au, Ag	001	033		78, 79, 69
455	Over Easy Bar Placer Occurrence	45 8 30.87 N	115 3 14.70 W	Au	024	025		79
456	Paddy Flat Placer Prospect	44 46 33.51 N	115 57 53.29 W	monazite, Nb, Ta	026	025		1
457	Painter Bar Placer Mine	45 25 1.49 N	115 27 55.25 W	Au	024	025		65
458	Painter Mine	45 25 23.91 N	115 27 38.91 W	Ag, Au	001	002		79, 65, 78
459	Panama Pacific Claims Prospect	45 10 48 N	116 38 05 W	Cu, Ag	010			2
460	Panhandle Group Prospect	44 58 58 N	115 13 39 W	Ag	018			79
461	Parrot Camp Placer Occurrence	45 11 30 N	114 41 50 W	Au	024	025		79
462	Patton Occurrence	45 09 49 N	116 35 25 W	Mo, W	014			11
463	Payboy Group Prospect	44 57 40 N	115 09 02 W	Au, Ag	018			79
464	Peacock Mine	45 10 10.18 N	116 39 3.85 W	Cu, Ag, Au	014			2, 19, 92
466	Pearl Occurrence	44 55 51 N	115 09 37 W	Ag	018			79
465	Pearl Placer Mine	45 14 35.11 N	115 39 29.50 W	Au	024	025		66
467	Pearl Prospect	44 59 43 N	115 04 29 W	Au, Ag	018			79
468	Pharmacist Prospect	45 13 02 N	115 21 08 W	Au	033			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix A. Mineral localities of Payette NF and vicinity, sorted alphabetically

map					Deposit Codes*			
no.	Mineral Locality	Latitude	Longitude	Commodity	dc1	dc2	dc3	References
469	Phonolite Group Prospect	44 58 15 N	115 10 45 W	Au, Ag	018			79
470	Pioneer Group Prospect	44 54 19.23 N	115 28 24.15 W	Sb, W	027	003	004	1
471	Placer Basin Mine	45 6 46.11 N	116 36 43.82 W	Au	007			11, 2
472	Placer Lake Prospect	45 9 46.53 N	115 21 15.85 W	Au	001			79
473	Point Placer Occurrence	45 6 1.08 N	114 50 36.69 W	Au	024	025		79
474	Poorman Mine	45 28 28.97 N	116 3 38.48 W	Au, Ag	001			94, 92
475	Portland Occurrence	45 12 50 N	115 14 56 W	Au	033			79
476	Potter Prospect	45 7 3.36 N	115 21 30.48 W	Au?, Ag?	001			
477	Powder Occurrence	45 12 25.61 N	115 19 50.89 W	Au	001			79
478	Profile - Yellow Pine Company Prospect	45 3 13.92 N	115 25 6.80 W	Au, W, Ag	001	027		69, 19
479	Profile Gap Prospect	45 3 32.17 N	115 24 32.84 W	W	027	014		102, 96, 89, 16
480	Pueblo Group Prospect	45 11 53.11 N	115 20 39.02 W	Au, Ag	001			79, 99
481	Pyramid Prospect Occurrence	44 56 04 N	115 14 32 W	Au, Ag	018			79
482	Quartz Creek Mine	44 58 39.21 N	115 28 4.30 W	W	004	001		102, 134
483	Queen Mine	45 7 36.27 N	116 38 40.23 W	Cu, Ag, Au	014			2
484	Railroad Mine	44 45 49.08 N	116 47 28.85 W	Cu, Ag, Au	014			76, 56, 47, 48, 42
485	Rainier Vein Prospect	45 14 6.62 N	115 41 28.85 W	Au, Ag?	001			66, 78
486	Rand-Mc Carthy Mine	45 2 44.19 N	116 50 31.69 W	Au, Cu, Ag	010	016		4, 10
487	Rare Earth Occurrence	44 53 18.13 N	115 14 58.80 W	REE, Ce, Hg, monazite, Zr	029			115
488	Rattlesnake Bar Placer Mine	45 32 54.60 N	115 9 1.64 W	Au, monazite	024	025	026	65
489	Rattlesnake Ridge Prospect	45 03 16 N	114 43 14 W	Au, Ag, Cu	033			79
490	Red Bird Prospect	45 28 55 N	116 03 25 W	Au	001			94
491	Red Bird Prospect	44 56 44 N	115 07 33 W	Au, Ag	018			79
492	Red Bluff Group	44 58 46 N	115 12 42 W	Au, Ag	018			79
493	Red Bluff Mine	45 9 39.10 N	115 23 53.56 W	W	005	004	002	99, 96
494	Red Ledge No. 30	45 13 28.72 N	116 41 58.47 W	Cu	017			
495	Red Ledge No. 6 Occurrence	45 16 10.24 N	115 37 14.43 W	U, REE	046			93
496	Red Ledge Prospect	45 13 43.32 N	116 40 9.73 W	Cu, Pb, Zn, Ag, Au	017			11, 19, 2, 20, 104, 18, 5, 130
497	Red Metal Mine	45 2 32.78 N	115 25 12.52 W	Au, Ag, Cu	001	002		69, 71, 72, 73
498	Red Mound	45 00 50 N	116 51 37 W	Cu, Ag, Pb, Zn	010			9
499	Red Mountain Mine Prospect	45 0 4.96 N	115 27 51.50 W	Au, Ag	002			1
500	Red Wing Occurrence	45 06 00 N	116 42 09 W	Cu	016			2
501	Redridge Group Mine	45 2 22.27 N	115 8 9.00 W	opal	020			79
502	Reilly Manganese Deposits Prospect	44 41 24 N	117 02 30 W	Mn	011			32
503	Rescue Decline Mine	45 15 25.88 N	115 40 3.08 W	Au	001			
504	Rescue Mine	45 15 26.21 N	115 40 6.18 W	Au	001			66, 97, 89, 92
505	Richardson Creek Bar Placer Occurrence	45 32 16.51 N	115 15 24.44 W	Au	024	025		79
506	Ridgetop Pit (proposed mine)	44 55 19.92 N	115 18 20.09 W	Au, Ag	002			137, 138, 139
507	Riley Prospect	44 47 42 N	116 46 57 W	Ag, Ba	012			56

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
508	Rising Star Prospect	44 57 50 N	115 07 55 W	Au	018			79
509	River Queen Mine	45 3 5.32 N	116 48 10.96 W	Cu, Ag, Au	010			11, 2, 13
510	Robbins Creek Placer Occurrence	45 25 45.04 N	116 1 32.56 W	U	025			14
511	Rock Flat Placer Mine	44 56 11.26 N	116 10 14.29 W	Au, garnet, monazite, gems	024	026	047	40, 41, 42, 43, 120, 83, 36, 1
512	Rocket Prospect	45 10 15.30 N	115 21 46.06 W	W, Cu	004	033		79, 99
513	Rogers Group Occurrence	45 03 26 N	116 48 34 W	Cu	010	016		4
514	Root Ranch Placer Occurrence	45 3 13.83 N	115 25 6.52 W	REE	026	025		79
515	Routson Prospect	45 08 09 N	115 19 12 W	Sb, Cu	001			101, 70
516	Ruby Creek Placer Mine	45 14 26.21 N	115 52 33.99 W	Au, monazite	024	025	026	88
517	Rush Peak Copper Occurrence	44 41 52 N	116 44 29 W	Cu	014			45
518	Ryan Creek Group Prospect	45 1 41.47 N	115 23 26.86 W	Cu, Pb, Zn	001	032	014	69
519	S And B Group Prospect	45 09 30 N	115 04 43 W	Ag, Cu	033			79
520	Safety Creek Occurrence	44 57 1.52 N	115 5 20.69 W	Au	018			79
521	Salmon Placer North Occurrence	45 22 36.68 N	115 30 42.16 W	Au	024	025		79
522	Salmon Placer South Occurrence	45 22 12.36 N	115 30 47.27 W	Au	024	025		79
523	Sand Creek Placer Mine	45 29 35.32 N	116 1 27.95 W	Au	024			94
524	Schissler Creek Placer Mine	45 19 23.73 N	115 43 33.91 W	Au	024	025		66
525	Schley No. 3 Group Occurrence	45 12 20.53 N	115 14 21.78 W	Au, Cu	033			79
526	Secesh - Ruby Placers Mine	45 14 58.36 N	115 53 27.34 W	Au, monazite	024	025	026	88
527	Shellrock Peak Prospect	44 56 18.16 N	114 54 7.33 W	Ag, Au, Cu, Pb	044			79
528	Sherman Howe Occurrence	45 24 35.15 N	115 51 58.67 W	Au	001			78
529	Short Line Prospect	44 57 44 N	115 08 02 W	Au, Ag	018			79
530	Silica Prospect	44 32 51.34 N	116 59 16.92 W	silica	021			30
531	Silver Anchor Prospect	45 08 12 N	115 19 07 W	Pb, Ag	001			70
532	Silver Bell Prospect	45 17 42.29 N	115 23 19.16 W	Au, Ag	001			79
533	Silver Cliff Lode Prospect	44 54 49.02 N	115 29 36.44 W	Sb, Ag	031			108, 118
534	Silver Dome Claim Prospect	45 10 26.07 N	115 5 5.29 W	Au, Cu, Ag	033			79
535	Silver King Mine	45 15 52.71 N	115 39 48.75 W	Ag, Au	001			66
536	Silver Monarch Mine	45 13 36.79 N	115 42 .72 W	Ag, Au	001			66, 91
537	Silver Still Mine	44 33 48.05 N	117 3 52.95 W	Ag, Au, Cu, Pb, Zn, Sn, Sb	009			61, 56, 59, 38
538	Simmons Placer Mine	45 5 11.18 N	115 7 43.77 W	Au	024			79
539	Skarn Prospect	44 36 39 N	116 55 60 W	Cu	014			53
540	Skookum Claim Prospect	45 03 18 N	114 59 11 W	Au, Ag	018			79
541	Slaughter Creek Placer Mine	45 15 44.96 N	115 39 56.65 W	Au	024			66
542	Slide Prospect Occurrence	44 49 25 N	115 20 03 W	Cu	044			79
543	Smith Creek Hydraulic Co. Placer Mine	45 10 18.97 N	115 18 58.71 W	Au	024	025		79
544	Smith Creek Placer Mines	45 15 39.58 N	115 40 59.47 W	Au, monazite	024	026		66
545	Smith Gulch Bar Placer Mine	45 29 9.69 N	114 58 32.84 W	Au, monazite	024	025	026	65
546	Smith Prospect	44 55 39 N	115 17 03 W	Hg	019			32, 114

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
547	Smothers Fluorspar Prospect	45 29 29.60 N	114 58 48.64 W	F	035			79
548	Snowbird Mine	45 9 38.43 N	115 24 26.48 W	W	005	004		99, 102, 96, 103
549	Snowshoe Mine	45 11 52.45 N	115 4 14.74 W	Au, Ag, Cu	033			79, 78
550	Snowslide Mountain Occurrence	45 5 11.17 N	115 14 30.68 W	Fe	033			79
551	Snowslide Occurrence	45 13 24.59 N	115 18 10.25 W	Au	001			79
552	Snowstorm Occurrence	45 26 05 N	115 51 30 W	Au	001			78
553	Soda Creek Uranium Occurrence	44 35 58.11 N	117 7 33.68 W	U	046			29
554	Soft Boil Bar Placer Occurrence	45 8 26.94 N	115 2 51.00 W	Au	024	025		79
555	South Fork Placer Mine	45 21 10 N	115 31 07 W	Au	024			
556	South Peacock Mine	45 9 56.69 N	116 38 55.00 W	Cu	014			11, 92
557	Splay Pit Mine	44 55 43.84 N	115 19 19.53 W	Au	002	030		137, 138, 139
558	Standard Mine	44 57 3.76 N	115 8 17.56 W	Au, Ag	018			69, 79
559	Standard Specularite Prospect	44 33 4.18 N	117 1 45.03 W	Fe	015			85, 35
560	Steamboat Creek Placer Mine	45 16 5.03 N	115 42 21.77 W	Au	024			66
561	Stibnite Pit (proposed mine)	44 55 38.91 N	115 19 10.22 W	Au, Ag	002	030		137, 138, 139
562	Stites Prospect	44 39 09 N	116 15 30 W	feldspar, mica	022			26
563	Stonebreaker Prospect	45 23 45 N	115 11 50 W	Cu, Ag, Au	033			69
564	Sturgill Creek Mine	44 40 35 N	117 02 48 W	Mn	011			34, 32, 11
565	Sturgill Creek Placer Mine	44 41 11 N	117 04 23 W	Au	024			31, 32
566	Submarine Claim Prospect	45 12 27.95 N	115 14 35.34 W	Au	033			79
567	Sugar Creek Antimony Prospect	44 56 33.64 N	115 18 57.55 W	Sb, Hg	003	019		1
568	Sulfide Prospect	45 11 00 N	115 15 35 W	Ag	001			79
569	Summit Creek Placer Mine	45 29 54.29 N	116 1 7.03 W	Au	024			94
570	Summit Vein Prospect	45 14 6.85 N	115 42 22.10 W	Au	001			66
571	Sunday Mine	45 6 58.03 N	115 20 36.41 W	Au?	001			
572	Sunlight Claims Prospect	45 10 33 N	115 08 15 W	Au, Cu, Ag	033			79
573	Sunnyside Mine	44 57 21.94 N	115 7 50.76 W	Au, Ag	018			79, 69, 19, 110, 130
574	Survey Creek Bar Placer Occurrence	45 3 22.58 N	114 43 21.73 W	Au	024	025		79
575	Survey Creek Placer Occurrence	45 3 26.28 N	114 43 34.15 W	Au	024	025		79
576	Syringa Occurrence	45 3 16.38 N	115 24 58.19 W	W	027			69
577	Talc Creek Prospect	45 03 46 N	115 08 06 W	Au	018			79
578	Tate Prospect	44 33 56.23 N	117 3 12.97 W	Cu, Zn	001			61
579	Ted's Group Prospect	45 15 30 N	114 48 03 W	W	004			79
580	Tempiute Prospect	44 57 19.19 N	115 9 7.16 W	Au, Ag	018			79
581	Tenderfoot Prospect	45 09 21 N	115 16 55 W	Au, Ag	001			79
582	Terrible Teddy Prospect	44 56 57 N	115 07 06 W	Au, Ag	018			79
583	Thomas Heady Prospect	45 12 21.04 N	116 39 17.76 W	Cu, Pb, Zn	017			2, 18
584	Thor Property Occurrence	44 47 49 N	116 48 19 W	Ag, Pb, Zn	009			55
585	Thorn Spring Occurrence	44 31 26.31 N	117 4 23.87 W	Cu, Mo, Zn	013			30

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map					Deposit Codes*			
no.	Mineral Locality	Latitude	Longitude	Commodity	dc1	dc2	dc3	References
586	Thorne Flat Prospect	45 0 39.32 N	116 51 .82 W	Cu	010	016		10
587	Thorpe Placer Mine	45 15 45.33 N	115 49 52.24 W	Au, garnet, monazite	024	025	026	90, 88
588	Three Mile Creek Placer Mine	45 18 11.01 N	115 55 49.00 W	Au, garnet, monazite	024	025	026	88, 21
589	Three Mile Prospect	44 55 59.35 N	115 11 2.02 W	Ag	018			79
590	Thunderation Group Occurrence	44 53 26 N	115 09 35 W	Au, Ag	018			79
591	Tough Nut Occurrence	45 15 13.77 N	115 41 51.55 W	Au, Ag	001			78
592	Tramp Mine	45 14 29.86 N	115 41 33.98 W	Au	001			66, 92
593	Transfer Point Occurrence	45 06 23 N	116 39 13 W	Cu	016			17
594	Trigold Prospect	45 4 14.04 N	115 25 28.21 W	Au, Ag	001			69
595	Tussel Mine	45 9 16.74 N	116 39 47.00 W	Cu, Au, Ag	014			11, 25
596	Tuttle Occurrence	45 23 2.71 N	115 49 34.16 W	Au	001			78
597	Twentieth Century Group Prospect	44 56 30.18 N	115 11 34.48 W	Au, Ag	018			79
598	Two Friends Claim Occurrence	45 8 50.08 N	115 3 37.28 W	Cu, Ag, Au	033			79
599	U. S. Mine	45 13 43.40 N	115 33 26.95 W	Au	001			94
600	Unity Mine	45 15 50.27 N	115 40 39.95 W	Au, Ag	001			66, 78
601	unnamed occurrence	45 15 59.91 N	115 42 58.73 W	Au	001			66
602	unnamed prospect	45 18 5.65 N	115 43 4.91 W	Au	001			66
603	unnamed prospect	45 16 13 N	115 41 38 W	Au	001			66
604	unnamed prospect	45 15 39.04 N	115 39 58.55 W	Au	001			66
606	unnamed prospect	45 14 57.01 N	115 42 24.67 W	Au	001			66
607	unnamed prospect	45 14 19.16 N	115 41 55.39 W	Au	001			66
608	unnamed prospect	45 3 18.06 N	116 47 7.11 W	Cu?	010			
609	unnamed prospect	45 6 24.29 N	116 37 5.37 W	Cu	010			
605	unnamed prospect	44 45 15.36 N	116 48 51.44 W	Fe, Cu	015			
610	unnamed vein occurrence	45 16 11.77 N	115 40 26.60 W	Au	001			66
611	unnamed vein prospect	45 14 33.15 N	115 40 40.70 W	Au	001			66
612	unnamed veins occurrence	45 17 13.26 N	115 43 16.17 W	Au	001			66
613	Upper Iron Clad Claims Prospect	45 06 27 N	115 06 40 W	Cu, Au, Ag	033			79, 69
614	Upper Kimmel Creek Occurrence	45 3 36.64 N	114 45 20.32 W	Au, Ag, Cu	033			79
615	Upper Ramey Meadows Placer Occurrence	45 17 19.87 N	115 13 10.81 W	Au, REE	024	025	026	79
616	Valentine Claim Prospect	45 08 24 N	114 59 18 W	Au, Ag	018			79
617	Valley View Claim Occurrence	45 13 15.84 N	115 16 10.45 W	Au, Cu	033			79
618	Vee Prospect	45 12 50.25 N	115 19 49.16 W	Au	001			79
619	Venable Mine	44 57 51.77 N	115 7 25.32 W	Au, Ag	018			69, 79
620	Vermillion Mine	44 54 29.03 N	115 16 39.65 W	Hg	019			68
621	Vesper Claim Occurrence	44 52 05 N	115 15 34 W	Ag, Au, Cu, Mo	013	001		79
622	Virginia Group Prospect	45 12 35.26 N	115 14 12.02 W	Cu	033			79
623	Virginia L. Claims Mine	44 35 56.94 N	117 7 2.27 W	Hg	019			46, 111, 52
624	W. K. No. 1 Claim Prospect	44 58 30 N	115 02 20 W	Au, Ag	018			79

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Latitude	Longitude	Commodity	Deposit Codes* dc1	dc2	dc3	References
625	Wabash Prospect	45 12 23 N	115 20 42 W	Au	001			79
626	War Eagle Mine	45 29 14.88 N	115 36 49.84 W	Au, Ag, Cu	001			86
627	War Eagle Prospect	45 19 32.67 N	115 47 45.67 W	Au, Fe	001			78, 77, 89
628	Warren Meadows Placer Mine	45 17 28.64 N	115 41 57.24 W	Au, Ag	024	025		100, 117, 66
629	Washington Prospect	45 25 32.68 N	115 51 45.23 W	Au	001			84, 72
630	Waverly Mine Prospect	45 30 9.42 N	116 2 29.11 W	Au	001	002		92
631	Webfoot Creek Placer Mine	45 13 58.05 N	115 41 17.80 W	Au	024			66
632	Werdenhoff Mine	45 11 46.45 N	115 20 45.12 W	Au, Ag	001	002		69, 79, 99, 78
633	West End Pit Mine	44 55 49.99 N	115 19 14.92 W	Au	002	030		109, 112, 136
634	West Fork Adit Prospect	45 0 38.08 N	115 10 23.82 W	Cu	044			79
635	West Fork Monumental Creek Placer Prospect	45 00 25 N	115 08 50 W	Au	024			79
636	White Metal Prospect	45 9 11.86 N	115 24 12.27 W	W	004	005		99
637	White Metal Prospect	44 54 18 N	115 16 50 W	Hg, Sb	019			109, 32
638	White Monument Mine	45 8 40.48 N	116 38 22.59 W	Cu, Ag, Au	014			2
639	White Sand Creek Placer Mine	45 29 51.45 N	116 2 8.66 W	Au	024			94
640	Widow Bar Placer Occurrence	45 28 55.59 N	115 20 55.92 W	Au	024	025		79
641	Wild Horse Copper Prospect	45 7 30.04 N	115 11 8.31 W	Cu	014			79
642	Wild West Group Prospect	45 11 58.84 N	115 16 44.47 W	Au, Ag, Cu	001			79
643	Wilford Prospect	45 5 30.53 N	116 41 53.99 W	Cu, Zn	016			2, 17
644	Wilson Group Mine	45 3 18.52 N	115 24 56.44 W	Au	001			69
645	Windy Ridge Occurrence	45 4 29.43 N	116 44 31.23 W	Cu	016			17
646	Wolf Fang Group Prospect	45 10 22 N	115 26 60 W	Au, Ag	001			79
647	Wolf Fang Peak Prospect 1	45 10 13.04 N	115 25 11.58 W	Au, Ag	001	002		79
648	Wolf Fang Prospect 2	45 10 51.02 N	115 24 36.06 W	Au, Ag	044			79
649	Wolf Occurrence	45 12 47 N	115 18 18 W	Au	001			79
650	Woolard Creek Placer Occurrence	45 3 28.74 N	114 43 24.56 W	Au	024	025		79
651	Yates Prospect	45 13 36.58 N	115 16 .42 W	Au	033			72
652	Yellow Jacket Group Prospect	45 11 38.62 N	115 5 13.04 W	Cu, Au, Ag	033			79, 19
653	Yellow Pine Bar Placer Mine	45 32 33.46 N	115 15 3.59 W	Au, monazite	024	025		65
654	Yellow Pine Pit Mine	44 55 38.13 N	115 20 4.76 W	Au, Ag, Sb, W	002	004	031	108, 109

*Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

References Cited in Appendix A

001 Commodity files, U.S. Geological Survey, Spokane, Washington.
002 Livingston, D.C., and Laney, F.B., 1920, The copper deposits of the Seven Devils and adjacent districts: Idaho Bureau of Mines and Geology Bulletin 1, 105 p.
003 Brooks, H.C., and Ramp, L., 1968, Gold and silver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 61, p. 93-100.
004 Oregon Department of Geology and Mineral Industries, 1939, Oregon metal mines handbook, northeastern Oregon, east half: Bulletin 14-A, p. 60.
005 Fredricksen, R., Gallaher, T.P., and Juhas, A.P., 1976, Precious and base metal mineralization at the Iron Dike and Red Ledge deposits (abs.): Northwest Mining Association Annual Convention Abstracts, Spokane, Washington.
006 Brooks, H.C., and others, 1981, Map of the geology and gold deposits of the Bourne Quadrangle, Baker and Grant counties, Oregon: Oregon Department of Geology and Mineral Industries Map GMS-19.
007 Vallier, T.L., 1974, A preliminary report on the geology of part of the Snake River Canyon, Oregon and Idaho: Oregon Department of Geology and Mineral Industries Map GMS-6.
008 Gammell, R.M., 1942, Olympic and Allen mines, Wallowa County, Oregon: U.S. Bureau of Mines War Minerals Memorandum, Project 216.
009 Hull, D.A., 1976, Summary report, Red Mound prospect: Oregon Department of Geology and Mineral Industries, unpublished report.
010 Brooks, H.C., and Vallier, T.L., 1970, Geology and copper deposits of the Homestead area, Oregon and Idaho: Oregon Department of Geology and Mineral Industries, The Ore Bin, v. 32, no. 3, p. 53.
012 Carter, W.D., and Savage, C.N. 1964, Mineral resources - Silica: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 180.
013 Vallier, T.L., and Brooks, H.C., 1970, Geology and copper deposits of the Homestead area, Oregon and Idaho: The Ore Bin, v. 32, no. 3, p. 54.
014 Armstrong, F.C., 1964, Mineral resources - Uranium: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 233-239.
015 Storch, R.H. and Holt, 1963, U.S. Bureau of Mines Report of Investigations 6319.
016 Lemmon, D.M., and Tweto, O.L., 1962, Tungsten in the U.S.: U.S. Geological Survey Map, MR-25.
017 Morganti, J.M., 1972, Geology and ore deposits of the Cuprum area, Seven Devils Mining district, Hells canyon, Idaho: Pullman, Washington, Washington State University, M.S. thesis, 153 p.
018 Long, R.C., 1976, Geology and mineral deposits of the Red Ledge mine area, Adams County, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 115 p.
019 U.S. Bureau of Mines, 1975, Activity of Idaho mining properties, 1974: U.S. Bureau of Mines, Boise, Idaho, 61 p.
020 Spokane Chronicle, June 1, 1971; Feb. 2, 1971; Dec. 8, 1970.
021 Lorain, S.H., and Metzger, D.H., 1938, Reconnaissance of placer mining districts in Idaho County, Idaho: U.S. Bureau of Mines Information Circular 7023, 93 p.
022 Stoll, W.C., 1950, Mica and beryl pegmatites in Idaho and Montana: U.S. Geological survey Professional Paper 229, 64 p.
023 Spokane Chronicle, Jan. 31, 1973; Nov. 9, 1973.
024 Mineral Survey 3570.
025 Cannon and Grimaldi, 1958, Lindgrenite and cuprotungstite from Seven Devils District, Idaho: American Minerals, v. 38.
026 Fryklund, V.C., Jr., 1951, A reconnaissance of some Idaho feldspar deposits: Idaho Bureau of Mines and Geology Pamphlet 91, p. 19-20.

027 Ross, C.P., and Carr, M.S., 1941, The metal and coal mining districts of Idaho, with notes on nonmetallic mineral resources of the state: Idaho Bureau of Mines and Geology Pamphlet 57, part 1.
028 Brooks, H.C., 1978, Geologic map of the Oregon part of the Mineral Quadrangle: Oregon Department of Geology and Mineral Industries map, GMS-12.
029 Matthews, T.C., 1955, Oregon radioactive discoveries in 1954 and 1955: Oregon Department of Geology and Mineral Industries, The Ore Bin, v. 17, no. 12, p. 88.
030 Henricksen, T., 1974, Geology and mineral deposits of the Mineral-Iron Mountain district, Idaho: Corvallis, Oregon State University, Ph.D. dissertation, p. 118-120.
031 Staley, W.W., 1945, Fine gold of the Snake river and lower Salmon River, Idaho: Idaho Bureau of Mines and Geology Pamphlet 72, p. 11.
032 Livingston, D.C., 1919, Tungsten, cinnabar, manganese, molybdenum, and tin deposits of Idaho: University of Idaho Bulletin, v. 14, no. 2, 72 p.
033 Withington, C.F., 1964, Mineral resources - Gypsum: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 101-104.
034 Prinz, W.C., 1964, Manganese: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 116-119.
035 Mackin, J.H., 1953, Iron ore deposits of the Iron Mountain district, Idaho: U.S. Geological survey bulletin 982-E, 30 p.
036 Shannon, E.V., 1926, Minerals of Idaho: U.S. National Museum Bulletin 131, p. 344.
037 Turner, H.W., 1908, The ore deposits at Mineral, Idaho: Economic Geology, v. 3, no. 6, p. 492-502.
038 Anderson, A.L., 1963, Silver mineralization in the Mineral district, Idaho: Economic Geology, v. 58, no. 8, p. 1195-1217.
039 Smolak, G.M., 1924, An investigation of the metallurgical treatment of a low grade silver ore from the Mineral mine at Mineral, Idaho: Moscow, Idaho, University of Idaho, M.S. thesis, 51 p.
040 Fryklund, V.C., Jr., 1951, Note on the occurrence of corundum in Idaho: American Mineralogist, v. 36, no. 9-10, p. 776-778.
041 Bell, R.N., 1907, Sapphires in Idaho: The Mining World, v. 26, p. 449.
042 Bell, R.N., 1907, Eighth annual report of the mining industry of Idaho for the year 1906, 172 p.
043 Bell, R.N., 1913, Fourteenth annual report of the mining industry of Idaho for the year 1912, 190 p.
044 Thayer, T.P., and Brown, C.E., 1964, pre-Tertiary orogenic and plutonic intrusive activity in central and northeast Oregon: Geological Society of America Bulletin, v. 75, no. 12, p. 1255-1262.
045 King, J.R., 1970, The geology of southeastern Cuddy Mountain district, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, p. 71.
046 Bailey, E.H., U.S. Geological Survey, personal files.
047 Fankhauser, R.E., 1969, Geology and mineralization of the southern Cuddy Mountains, Washington County, Idaho: Corvallis, Oregon, Oregon State university, M.S. thesis, 138 p.
048 Bruce, W.R., 1971, Geology, mineral deposits, and alteration of parts of the Cuddy mountain District, western Idaho: Corvallis, Oregon, Oregon State University, Ph.D. thesis, 165 p.
049 Slater, M.N., 1969, Geology and mineral deposits of the western Cuddy Mountain district, western Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 82 p.
050 Storch, R.H., 1958, Ilmenite and other black-sand minerals in the Gold Fork placer deposit, Valley County, Idaho: United States Bureau of Mines Report of Investigations 5395, 15 p.

051 Staley, W.W., 1962, Four V: Idaho Bureau of Mines and Geology Open-file Report.
052 Ross, C.P., 1956, Quicksilver deposits near Weiser, Washington County, Idaho: U.S. Geological Survey Bulletin 1042-D, p. 79-104.
053 Skurla, S.J., 1974, Geology of the Sturgill Peak area, Washington County, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 98 p.
054 Staley, W.W., 1955, Burntrock prospect: Idaho Bureau of Mines and Geology Open-file Report, 2 p.
055 Western Mining News, March 18, 1977, p. 10-11.
056 Livingston, D.C., 1923, A geologic reconnaissance of the Mineral and Cuddy Mountain mining districts, Washington and Adams counties, Idaho: Idaho Bureau of Mines and Geology, Pamphlet 13, 24 p.
057 Western Mining News, March 14, 1975.
058 Bell, R.N., 1919, The IXL copper prospect: Engineering and Mining Journal, v. 108, no. 10, p. 400-402.
059 Idaho Department of Labor and Industrial Services, First Annual Report Addendum, July 1, 1974 - June 30, 1975, 95 p.
060 Wracher, David, 1969, The geology and mineralization of the Peck Mountain area, Hornet Quadrangle, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 78 p.
061 Anderson, A.L., and Wagner, W.R., 1952, Reconnaissance geology and ore deposits of the Mineral district, Washington County Idaho: Idaho Bureau of Mines and Geology Pamphlet 95, 26 p.
062 Lesure, F.G., 1964, Mica and associated pegmatite minerals: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 123-133.
063 Savage, C.N., 1961, Economic geology of central Idaho blacksand placers: Idaho Bureau of Mines and Geology Bulletin 17, p. 12.
064 Asher, R.R., 1964, Mineral resources - Iron: in Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 104-111.
065 Weis, P.L., Schmitt, L.J., and Tuchek, E.T., 1972, Mineral resources of the Salmon River Breaks Primitive Area, Idaho: U.S. Geological Survey Bulletin 1353-C, p. 55.
066 Reed, J.C., 1937, Geology and ore deposits of the Warren mining district, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 45, 65 p.
067 Pattee, E.C. and others, 1968, Beryllium resources of Idaho, Washington, Montana, and Oregon: U.S. Bureau of Mines Report of Investigations 7148, 169 p.
068 Mercury in Idaho, 1965: U.S. Bureau of Mines Information Circular 8252.
069 Shenon, P.J., and Ross, C.P., 1936, Geology and ore deposits near Edwardsburg and Thunder Mountain, Idaho: Idaho Bureau of Mines and Geology Pamphlet 44, 45 p.
070 Lindsey, E., 1958, Geology and ore deposits of the northern half of the big Creek Quadrangle, Idaho: Berkeley, California, University of California, M.S. thesis, 67 p.
071 Spence, R.L., 1936, Geology and ore deposits of the Red Metals mine, Yellow Pine district, Idaho: Moscow, Idaho, University of Idaho, B.S. thesis, 19 p.
072 Bell, R.N., 1912, Thirteenth annual report of the mining industry of Idaho for the year 1911.
073 Mining and Scientific Press, 1914, Big Creek mining district: Mining and Scientific Press, v. 109, p. 110-111.
074 Bell, R.N., 1920, Twenty-first annual report of the mining industry of Idaho for the year 1919.
075 Jacobs, M.H., 1903, Report of the mining districts of Idaho for the year 1902.
076 Bell, R.N., 1904, Report of the mining districts of Idaho for the year 1903.

077 Mackin, J.H., 1947, Iron ore deposits in the Clearwater district, Idaho County, Idaho: U.S. Geological Survey Open-file Report, 20 p.
078 Lorain, S.H., 1938, Gold mining and milling in Idaho County, Idaho: U.S. Bureau of Mines Information Circular 7039, 90 p.
079 Cater, F.W., and others, 1973, Mineral resources in the Idaho Primitive Area and vicinity, Idaho: U.S. Geological Survey Bulletin 1304, 431 p.
080 Capps, S.R., and Roberts, R.J., 1939, The Dixie placer district, Idaho: Idaho Bureau of Mines and Geology Pamphlet 48, 35 p.
081 Roberts, R.J., 1938, The petrography and ore deposits of the Dixie district, Idaho: Seattle, Washington, University of Washington, M.S. thesis, 61 p.
082 O'Connor, D.M., 1936, Treatment of ore from the Dixie Comstock gold mine, Dixie Idaho: Seattle, Washington, University of Washington, B.S. thesis, 49 p.
083 Bell, R.N., 1905, Report of the mining districts of Idaho for the year 1904.
084 Bell, R.N., 1908, Ninth annual report of the mining industry of Idaho for the year 1907.
085 Bell, R.N., 1918, Nineteenth annual report of the mining industry of Idaho for the year 1917.
086 Shenon, P.J., and Reed, J.C., 1934, Geology and ore deposits in the Elk City, Orogrande, Buffalo Hump, and Tenmile districts, Idaho County, Idaho: U.S. Geological Survey Circular 9, 89 p.
087 Jones, R.W., 1959, Durden Mine: Idaho Bureau of Mines and Geology Open-file Report.
088 Capps, S. R., 1940, Gold placers of the Secesh Basin, Idaho county, Idaho: Idaho Bureau of Mines and Geology Pamphlet 52, 43 p.
089 Griner, W.C., 1975, Seventy-first annual report of the mining industry of Idaho for 1973-1974, 98 p.
090 Sorenson, R., 1937, Minerals from certain placer deposits in Idaho: Moscow, Idaho, University of Idaho, B.S. thesis, 22 p.
091 Czizek, J.A., 1900, Report of the Inspector of Mines for the State of Idaho for the year 1899.
092 Lindgren, W., 1900, The gold and silver veins of Silver City, De Lamar, and other mining districts in Idaho: U.S. Geological Survey 20th Annual Report, Part III, p. 67-256.
093 Powers, H.A., 1955, Red Ledge No. 6.: Idaho Bureau of Mines and Geology Open-file Report.
094 Reed, J.C., 1939, Geology and ore deposits of the Florence mining district, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 46, 44 p.
095 Spokane Chronicle, Nov. 3, 1972; April 24, 1972; Nov. 15, 1971.
096 Hobbs, S.W., 1964, Mineral resources - Tungsten: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 223-233.
097 Pointon, S.J., 1921, Warren mining district: Northwest Mining Truth, v. 6, no. 13, p. 3-4.
098 Hill, W.H., 1896, The Little Giant mine at Warren, Idaho: Engineering Mining Journal, v. 62, p. 416.
099 Kirkpatrick, G.E., 1974, Geology and ore deposits of the Big Creek area, Valley and Idaho counties, Idaho: Moscow, Idaho, University of Idaho, M.S. thesis, 92 p.
100 Koschmann, A.H., and Bergendahl, M.H., 1968, Principal gold-producing districts of the United States: U.S. Geological Survey Professional Paper 610, p. 133.
101 Leonard, B.F., 1965, Mercury-bearing antimony deposit between Big Creek and Yellow Pine, central Idaho: U.S. Geological Survey Professional Paper 525-B, p. 27.
102 Cook, E.F., 1956, Tungsten deposits of south-central Idaho: Idaho Bureau of Mines and Geology Pamphlet 108, 40 p.

103 Leonard, B.F., and others, 1968, Silver-rich disseminated sulfides from a tungsten-bearing quartz lode, Big Creek district, central Idaho: U.S. Geological Survey Professional Paper 594-C.
104 Western Mining News, July 5, 1974. Also Western Min. News, 1974-75 Directory of Mines in Idaho (Coeur d'Alenes) and Washington, p. 29.
105 Western Mining News, May 2, 1975.
106 Western Mining News, Nov. 21, 1975.
107 Cole, J.W., and Bailey, H.D., 1948, Exploration, development, mining, and milling of a unique tungsten ore body at Yellow Pine Mine, Stibnite, Idaho: U.S. Bureau of Mines Information Circular 7443, 24 p.
108 Schrader,F.C., and Ross, C.N., 1926, Antimony and quicksilver deposits in the Yellow Pine district, Idaho: U.S. Geological Survey Bulletin 780, p. 137-167.
109 Currier, L.W., 1935, A preliminary report of the geology and ore deposits of the eastern part of the Yellow Pine district, Idaho: Idaho Bureau of Mines and Geology Pamphlet 43, 27 p.
11 Cook, E.F., 1954, Mining geology of the Seven Devils region: Idaho Bureau of Mines and Geology Pamphlet 97, 22 p.
110 Ross, C.P., 1927, Ore deposits in the Tertiary lava in the Salmon River Mountains, Idaho: Idaho Bureau of Mines and Geology Pamphlet 57, part 1.
111 Bailey, E.H., 1964, Mineral resources - Mercury: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p.199-123.
112 Metal Market Consultants, Inc., 1987, Gold situation map.
113 Laheist, B.A., 1964, Mineral resources - Antimony: *in* Mineral and Water Resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 41-46.
114 Bell, R.N., 1919, Twentieth annual report of the mining industry of Idaho for the year 1918.
115, 128, 132 Adams, J.O., 1968, Rhabdophane from a rare-earth occurrence, Valley County, Idaho: U.S. Geological Survey Professional Paper 600-B, p. B48-B51.
116, 138, 137 Cooper, J.R., 1951, Geology of tungsten, antimony, and gold deposits near Stibnite, Idaho: U.S. Geological Survey Bulletin 969-F, p. 151-197.
117 Minobras, 1975, Idaho industrial minerals: Minobras, p. 34-36.
118 Bell, R.N., 1935, The gold resources of Idaho: Mining and Contracting Review, v. 33, no. 37.
119 Mining Record, Dec. 6, 1972.
120 Bell, R.N., 1914, Fifteenth annual report of the mining industry of Idaho for the year 1913, 225 p.
121 Campbell, A., 1947, Forty-eighth annual report of the mining industry of Idaho for the year 1946.
122 Campbell, A., 1946, Forty-seventh annual report of the mining industry of Idaho for the year 1945.
123 U.S. Bureau of Mines Yearbook, 1943; 1944; 1946.
124 Idaho Bureau of Mines and Geology, 1970, Open File Report on Antimony.
130 Varley and others, 1919, p. 43, 51, 45-47.
134 Peterson, M.A., 1984, Geology of the quartz Creek tungsten deposit, Yellow Pine, Idaho: M.S. thesis, Kent State University, 94 p.
135 Shrader and Ross, 1926, Antimony and quicksilver deposits of the Yellow Pine district, Idaho: U.S. Geological Survey Bulletin 780, p. 137-165.
136 Leonard, B.F., 1973, Gold anomaly in soil of the West End Creek area, Yellow Pine district, Valley county, Idaho: U.S. Geological Survey Circular 680, 16 p.

Appendix B.

Mineral localities of the Payette NF and vicinity, sorted by deposit type

(showing name, deposit-type codes, mining district, commodities, minerals, and deposit form)

Deposit Code	Deposit Type
001	Gold-silver Mixed-metal Veins
002	Distal Disseminated Gold-silver
003	Antimony Veins
004	Tungsten Veins -- Quartz-scheelite
005	Tungsten Veins -- Quartz-huebnerite
007	Low-sulfide Gold-quartz Veins
009	Polymetallic Layers and Veins
010	Copper-silver Polymetallic Veins
011	Manganese Layers and Veins
012	Barite Layers and Veins
013	Porphyry Copper-molybdenum
014	Copper Skarn
015	Iron Skarn
016	Disseminated Copper-silver
017	Kuroko Zinc-copper massive sulfide
018	Hot-spring Gold-silver
019	Hot-spring Mercury
020	Opal
021	Quartz -- Pegmatite, Vein
022	Mica -- Pegmatite
023	Gypsum and Anhydrite
024	Gold Placer
025	Black-sand Placer
026	Rare-earth Placer
027	Tungsten Skarn
029	Rare-earth Lode
030	Gold Skarn
031	Disseminated Antimony
032	Zinc-lead Skarn
033	Copper-gold Mixed-metal Veins
034	Copper-silver-gold Pegmatite
035	Quartz-fluorite Veins
038	Magmatic Iron-Copper
044	Unclassified
046	Uranium, unclassified
047	Gem Placer
049	Diamond Pipes
050	Ag-Au Polymetallic Veins

Deposit codes for types of mineral deposits in the Payette NF and vicinity

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
10	Alberta Mine	001			Marshall Lake	Au, Ag	gold, limonite	vein
13	Ann Nos. 1 And 2 Prospect	001			Salmon River (undefined)	Au, Ag, Pb, Zn	galena, sphalerite	vein
15	Antimony Rainbow Group Mines	001	005	002	Edwardsburg	W, Cu, Sb, Au, Ag	tetrahedrite, scheelite, argentite, chalcopyrite, sphalerite, huebnerite	vein swarm, stockwork, tactite
20	Arlise Vein Mine	001			Warren	Au	sphalerite, gold, arsenopyrite	vein
22	Azurite Prospect	001			Mineral	Cu, Zn	chalcopyrite, sphalerite, malachite	vein
28	Banner Mine	001			Florence	Au, Ag	gold, silver sulfides	vein
33	Bear Track Mine	001			Warren	Au	sulfides	vein
41	Big 4 Occurrence	001			Edwardsburg	Au, Ag	gold, silver	vein
53	Black Bear Prospect	001			Florence (north of PNF)	Au	native gold	vein
54	Black Diamond Mine	001			Dixie (north of PNF)	Au	galena, sphalerite, chalcopyrite	vein
59	Black Swan Prospect	001			Edwardsburg	Au, Ag	gold, silver	vein
61	Blossom Mine	001			Florence (north of PNF)	Au	gold	vein
62	Blue Bluff Prospect	001			Edwardsburg	Cu	azurite, malachite	vein
64	Blue Stone Prospect	001			Edwardsburg	Au, Ag	galena, tetrahedrite, malachite, azurite, pyrite	vein
84	Bullion Lode Silver Mine	001			Florence (north of PNF)	Ag, Au		vein
92	Camp Bird No. 1 Occurrence	001			Edwardsburg	Au, Ag		lode
103	Charity Mine	001	004		Warren	Au	scheelite, minor sulfides, gold	vein, placer
109	Cleveland Mine	001			Edwardsburg	Ag	sulfides	vein
115	Combination Mine	001	032	005	Profile	Pb, Ag, Zn	chalcopyrite, magnetite, sphalerite, galena, chalcocite, pyrite, bornite	vein, skarn
125	Copper King Prospect	001			Yellow Pine	Au, Ag, Cu, Sb	pyrite, stibnite	vein
130	Cottonwood Butte Prospect	001	050		Salmon River (undefined)	Ag		vein
136	Crest Prospect	001			Edwardsburg	Au	gold	shear
144	D. D. Prospect	001			Edwardsburg	Au		vein
145	Dagnapan Prospect	001	002		Edwardsburg	Au, Ag		vein, shear zone
146	Daisy Prospect	001			Marshall Lake	Au	sulfides	vein
151	Delaware Mine	001			Warren	Au	gold	vein
152	Dennett Creek Prospect	001			Mineral	Au, Cu	chalcopyrite, sphalerite	vein
155	Dewey Vein Prospect	001			Warren	Au	stibnite, galena, mottramite, pyrite	vein
159	Dixie Comstock Mine	001			Dixie (north of PNF)	Au, Pb	gold, galena	vein
160	Dixie Mine	001	002		Edwardsburg	Au, Ag, W	sphalerite, chalcopyrite, galena, scheelite, huebnerite	shear zone, vein
171	Duerden Prospect	001			Resort	Au, Pb, Zn, Ag	galena, sphalerite, covellite, bornite, chalcopyrite	shear zone
173	Dynamite Prospect Occurrence	001			Edwardsburg	Au	gold	vein
181	Elkhorn Prospect	001			Florence (north of PNF)	Au	native gold	vein
182	Emly Mine	001			Warren	Au, Ag	tetrahedrite, galena, sphalerite, free gold	vein

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
194	Fourth of July Mine	001			Edwardsburg	Au, Ag	sphalerite, huebnerite, stibnite?, black sulfosalts, galena, pribramite?	vein
200	Galena Central Prospect	001	032		Profile	Pb, Zn, Cu, W, Ag, Au	galena, sphalerite, scheelite	vein/replacement
205	Gayety Vein Prospect	001			Warren	Au	sulfides, gold	vein
208	Gilt Edge Prospect	001			Florence (north of PNF)	Au	native gold	vein
209	Glasgow Prospect	001			Profile	Au	free gold, pyrite, galena, stibnite?, chalcopyrite	vein
214	Gold Bug Mine	001			Florence (north of PNF)	Au	gold, tellurides have been reported	vein
223	Gold King Mine	001			Warren	Au, Ag	sulfides	vein
228	Gold Rock #2 Prospect	001			Warren	Au	gold	vein
229	Gold Run Mine	001			Marshall Lake	Au	galena, sphalerite, free gold	vein
231	Golden Anchor Mine	001			Marshall Lake	Au, Ag	malachite, cerargyrite, tetrahedrite, galena, sphalerite, scheelite, free gold	vein
235	Golden Cup Prospect	001	002		Edwardsburg	Cu, Au	chalcopyrite, gold, pyrite, sphalerite, huebnerite, fluorite, stibnite	shear zone
236	Golden Gate Prospect	001	031		Yellow Pine	Au, Ag, Sb	stibnite, pyrite	vein, disseminated
239	Golden Hand Mine	001	002		Edwardsburg	Au, Ag	tetrahedrite, galena, sphalerite, chalcopyrite, gold, malachite	vein
242	Golden Way Up Mine	001	002		Edwardsburg	Au	fluorite, tetrahedrite, sphalerite, galena, covellite, azurite, malachite	vein, vein
243	Golden West Mine	001	003	002	Big Creek	Sb, W, Au	stibnite, scheelite, gold	vein/shear zone, stockwork, dissem.
246	Goodenough Mine	001			Warren	Au, Ag	sphalerite, ruby silver, tetrahedrite, gold, pyrite, arsenopyrite	vein
250	Grandview Claims Prospect	001			Warren	Au	gold	vein
256	Green Spider Prospect	001	002		Edwardsburg	Sb, Cu	tetrahedrite	vein
268	Harris - Holte Mine	001			Marshall Lake	Au	sulfides, free gold	vein
272	Hen Creek Prospect	001			Salmon River (undefined)	Ag		fissure vein
276	Hercules Prospect	001			Edwardsburg	Au	gold	vein
279	Hermit Hanks Prospect	001	050		Salmon River (undefined)			vein
280	Hi Yu Mine	001			Florence (north of PNF)	Au	gold	vein
285	Hilltop Occurrence	001			Edwardsburg	Au	gold	vein
286	Hinkson - Bishop Mine	001			Marshall Lake	Au, Ag	galena, sphalerite, free gold	vein
289	Hollister Prospect	001			Edwardsburg	Au		vein/shear zone
290	Holmadge Prospect	001			Florence (north of PNF)	Au	native gold	vein
295	Hornet Vein Prospect	001			Warren	Au	gold	vein
303	Hyatt Prospect	001			Marshall Lake	Au	galena, sphalerite	vein
308	Imperial Prospect	001	050		Chamberlain Basin	Au, Ag	tetrahedrite	vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
309	Independence Prospect	001	002		Edwardsburg	Au, Ag	fluorite, sphalerite, tetrahedrite, galena, bertrandite, scheelite, arsenopyrite	vein, disseminated
312	Iola Mine	001			Warren	Au, Ag	sulfides, copper stains, gold	vein
325	July Blizzard Prospect	001			Edwardsburg	Au	gold	vein
327	Juno Prospect	001			Marshall Lake	Au	sulfides	vein
333	Kingfish Occurrence	001			Warren	Au	sulfides	vein
335	Knott Mine	001			Warren	Au	gold	vein
338	Ladwick Group Occurrence	001			Edwardsburg	Au		vein
340	Lakeside Prospect	001			Edwardsburg	Au, W	scheelite	vein
343	Larsen Mine Prospect	001			Warren	Au	gold	vein
345	Last Chance Claim Prospect	001			Warren	Au	sulfides	vein
349	Liberty Prospect	001			Florence (north of PNF)	Au		vein
354	Linton Mine	001	024		Warren	Au	gold	vein, placer
359	Little Giant Mine	001	004	005	Warren	Au, Ag	gold, tetrahedrite, galena, sphalerite, tellurides, argentite, native silver	vein
363	Little Sheepeater Prospect	001			Salmon River (undefined)	Ag, Au	galena, sulfides	vein
368	Lost Packer Prospect	001			Edwardsburg	Au, Cu, Sb, Zn	chalcopyrite, tetrahedrite, sphalerite, pyrite, arsenopyrite (?)	vein
369	Lotspiech Prospect	001			Edwardsburg	Au?		vein
374	Lucky Ben Mine	001			Warren	Au	gold	vein
376	Lucky Boy Occurrence	001			Edwardsburg	Au	gold	vein
378	Ludwig Prospect	001	002	004	Edwardsburg	Au, Ag, W	scheelite, huebnerite, gold, argentite, chalcopyrite, tetrahedrite, sphalerite	subparallel veins, dissem.
384	Mammoth Prospect	001	002		Dixie (north of PNF)	Au, Pb, Zn, Cu	galena, sphalerite, chalcopyrite	shear zone, disseminated
391	Mayflower Mine	001			Warren	Au	gold	vein
396	Meadow Creek Mine	001			Yellow Pine	Au, Ag, Sb	stibnite, gold, scheelite, pyrite, arsenopyrite	vein
406	Minnehaha Vein Prospect	001			Warren	Ag, Au	sulfides, copper stains, stibnite	vein
408	Mohawk Vein Occurrence	001			Warren	Au	sulfides	vein
411	Monitor Vein Prospect	001			Warren	Au	sulfides	vein
422	Moscow Mine	001	002		Edwardsburg	Au	sphalerite, galena, tetrahedrite, chalcopyrite, free gold, pyrite	vein/fault, veinlets/dissem.
427	Mt. Marshall Prospect	001			Marshall Lake	Au	sulfides	vein
430	Mulligan Group Prospect	001			Ramey Ridge	Au, Ag	stibnite	vein
434	Nelly More Occurrence	001			Edwardsburg	Au, Ag	sulfides	vein
452	Old Kentuck Prospect	001			Marshall Lake	Au	sulfides	vein
454	Orofino Group Mine	001	033		Ramey Ridge	Au, Ag	chalcopyrite, bismuth, tungsten	vein
458	Painter Mine	001	002		Salmon River (undefined)	Ag, Au	galena, free gold	shear zone, disseminated

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
472	Placer Lake Prospect	001			Edwardsburg	Au		vein
474	Poorman Mine	001			Florence (north of PNF)	Au, Ag	gold, silver, ruby silver, and horn silver (cerargyrite)	vein
476	Potter Prospect	001			Edwardsburg	Au?, Ag?	pyrite, arsenopyrite?, galena, sphalerite, arsenopyrite	v
477	Powder Occurrence	001			Edwardsburg	Au	gold	vein
478	Profile - Yellow Pine Company Prospect	001	027		Edwardsburg	Au, W, Ag	chalcopyrite, sphalerite, galena, tetrahedrite, covellite, scheelite	vein, contact metamorphic
480	Pueblo Group Prospect	001			Edwardsburg	Au, Ag	gold, silver	vein
485	Rainier Vein Prospect	001			Warren	Au, Ag?	sulfides	vein
490	Red Bird Prospect	001			Florence (north of PNF)	Au	native gold	vein
497	Red Metal Mine	001	002		Edwardsburg	Au, Ag, Cu	galena, sphalerite, tetrahedrite, chalcopyrite, bornite, native silver	vein, shear zone
503	Rescue Decline Mine	001			Warren	Au	gold, galena, sphalerite	vein
504	Rescue Mine	001			Warren	Au	free gold, sphalerite, galena, tetrahedrite, argentite	vein
515	Routson Prospect	001			Big Creek	Sb, Cu	stibnite, chalcopyrite	vein
518	Ryan Creek Group Prospect	001	032	014	Edwardsburg	Cu, Pb, Zn	sphalerite, galena, chalcopyrite	replacement, vein
528	Sherman Howe Occurrence	001			Marshall Lake	Au	sulfides	vein
531	Silver Anchor Prospect	001			Big Creek	Pb, Ag	galena	vein
532	Silver Bell Prospect	001			Chamberlain Basin	Au, Ag		vein
535	Silver King Mine	001			Warren	Ag, Au	sulfides	vein
536	Silver Monarch Mine	001			Warren	Ag, Au	sulfides	vein
551	Snowslide Occurrence	001			Edwardsburg	Au	gold	vein
552	Snowstorm Occurrence	001			Marshall Lake	Au	sulfides	vein
568	Sulfide Prospect	001			Ramey Ridge	Ag	sulfides	vein
570	Summit Vein Prospect	001			Warren	Au	gold, sphalerite	vein
571	Sunday Mine	001			Edwardsburg	Au?	pyrite, arsenopyrite?, galena, sphalerite	vein
578	Tate Prospect	001			Mineral	Cu, Zn	chalcopyrite, sphalerite	vein
581	Tenderfoot Prospect	001			Edwardsburg	Au, Ag		vein
591	Tough Nut Occurrence	001			Warren	Au, Ag	sulfides	vein
592	Tramp Mine	001			Warren	Au	gold, chalcopyrite?, tetrahedrite?	vein
594	Trigold Prospect	001			Edwardsburg	Au, Ag	sphalerite, galena, chalcopyrite, tetrahedrite, pyrargyrite	vein
596	Tuttle Occurrence	001			Marshall Lake	Au	sulfides	vein
599	U. S. Mine	001			Florence (north of PNF)	Au	native gold	vein
600	Unity Mine	001			Warren	Au, Ag	gold, tetrahedrite, galena, sphalerite, argentite	vein
601	unnamed occurrence	001			Warren	Au	sulfide	vein
602	unnamed prospect	001			Warren	Au	sulfides?	vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
603	unnamed prospect	001			Warren	Au		vein
604	unnamed prospect	001			Warren	Au	sulfide	vein
606	unnamed prospect	001			Warren	Au	gold	vein
607	unnamed prospect	001			Warren	Au	gold	vein
610	unnamed vein occurrence	001			Warren	Au	sulfides	vein
611	unnamed vein prospect	001			Warren	Au	gold	vein
612	unnamed veins occurrence	001			Warren	Au	sphalerite, galena, tetrahedrite, mimetite	vein
618	Vee Prospect	001			Edwardsburg	Au	gold	vein
625	Wabash Prospect	001			Edwardsburg	Au	gold	vein
626	War Eagle Mine	001			Buffalo Hump (north of PNF)	Au, Ag, Cu	galena, chalcopyrite, sphalerite, tetrahedrite, gold, telluride, argentite	vein
627	War Eagle Prospect	001			Marshall Lake	Au, Fe	magnetite	vein
629	Washington Prospect	001			Marshall Lake	Au	sulfides	vein
630	Waverly Mine Prospect	001	002		Florence (north of PNF)	Au	gold	vein
632	Werdenhoff Mine	001	002		Edwardsburg	Au, Ag	sphalerite, galena, tetrahedrite, pyrite, arsenopyrite, gold	vein
642	Wild West Group Prospect	001			Ramey Ridge	Au, Ag, Cu	chalcopyrite	vein
644	Wilson Group Mine	001			Edwardsburg	Au	sphalerite, galena, stibnite, tetrahedrite, stibiconite, kermesite, chalcopyrite	vein
646	Wolf Fang Group Prospect	001			South Fork Salmon (undefined)	Au, Ag	sulfides	vein
647	Wolf Fang Peak Prospect 1	001	002		South Fork Salmon (undefined)	Au, Ag	sulfides	vein, disseminated
649	Wolf Occurrence	001			Edwardsburg	Au	gold	vein
69	Bonanza Prospect	002			Yellow Pine	Au, Ag		disseminated
76	Broken Hill Pit (proposed mine)	002			Yellow Pine (Stibnite subdist.)	Au, Ag	gold	disseminated, oxidized
107	Cinnamid Pit (proposed mine)	002	030		Yellow Pine (Stibnite subdist.)	Au, Ag	gold	disseminated, in calc-silicate hornfels, oxidized
165	Doris K. Pit (proposed mine)	002	030		Yellow Pine (Stibnite subdist.)	Au, Ag	gold	disseminated in calc-silicate hornfels, oxidized
202	Garnet Creek Pit Mine	002	030		Yellow Pine (Stibnite subdist.)	Au, Ag	gold	disseminated in calc-silicate hornfels, oxidized
203	Garnet Creek Prospect	002	027	031	Yellow Pine (Stibnite subdist.)	Au, Ag	pyrite, arsenopyrite, stibnite, scheelite , magnetite, garnet, tactite	vein/shear zone, replacement
291	Homestake Pit Mine	002			Yellow Pine	Au, Ag	gold, pyrite, arsenopyrite	vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
328	Kennedy Prospects	002	003		Yellow Pine	Au, Sb	stibnite	vein/shear zone, disseminated
382	Madam Queen Prospect	002	003		Yellow Pine	Au	pyrite, arsenopyrite, stibnite	vein/shear zone, replacement
402	Midnight Pit Mine	002			Yellow Pine (Stibnite)	Au, Ag	gold, limonite	vein, disseminated
410	Monday Prospect	002	001		Yellow Pine	Au, Sb	stibnite, pyrite, arsenopyrite	vein/shear zone, replacement
435	Nethken Prospect	002	003		Yellow Pine	Sb, Au	stibnite	vein/shear zone, replacement
445	North Monday Occurrence	002	019		Yellow Pine	Au, Hg	cinnabar	vein, replacement
446	North Tunnel Prospect	002	001		Yellow Pine	Au, Sb	stibnite	vein/shear zone, disseminated
499	Red Mountain Mine Prospect	002			Profile	Au, Ag	pyrite, scheelite, molybdenite, arsenopyrite, pyrrhotite	stockwork/veins and dissem.
506	Ridgetop Pit (proposed mine)	002			Yellow Pine (Stibnite subdist.)	Au, Ag	gold	disseminated, oxidized
557	Splay Pit Mine	002	030		Yellow Pine (Stibnite subdist.)	Au	gold	disseminated in calc-silicate hornfels, oxidized
561	Stibnite Pit (proposed mine)	002	030		Yellow Pine (Stibnite subdist.)	Au, Ag	gold	disseminated in calc-silicate hornfels, oxidized
633	West End Pit Mine	002	030		Yellow Pine (Stibnite subdist.)	Au	gold bearing limonite	dissem. in calc-silicate hornfels, oxidized
654	Yellow Pine Pit Mine	002	004	031	Yellow Pine (Stibnite subdist.)	Au, Ag, Sb, W	stibnite, gold, scheelite	vein, disseminated, replacement
14	Antimony Bar No. 1 Prospect	003			Warren	Sb	stibnite	vein
16	Antimony Ridge Mine	003	031		Yellow Pine	Sb, Ag, Au	stibnite	vein, shear zone
23	B And B No. 4 Prospect	003	001		Big Creek	Hg, Sb, Ag	stibnite, cinnabar, sphalerite, boulangerite, covellite, barite, tetrahedrite	vein/shear zone, contact metamorphic
164	Dokka Mine	003			Edwardsburg	Sb		Sb vein
166	Doris K. Prospect	003	031		Yellow Pine (Stibnite subdist.)	Sb	stibnite	vein, disseminated
366	Logan Copper Hill Prospect	003	014		Big Creek	Sb, Cu	stibnite, chalcopyrite, garnet	vein, contact metamorphic
567	Sugar Creek Antimony Prospect	003	019		Yellow Pine	Sb, Hg	stibnite, cinnabar	veins

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
237	Golden Gate Tungsten Mine	004	002		Yellow Pine	W	scheelite	replacement, shear zone
390	Marygold Property	004			Marshall Lake	W	scheelite	vein
482	Quartz Creek Mine	004	001		Profile	W	scheelite	vein, skarn
512	Rocket Prospect	004	033		Edwardsburg	W, Cu	scheelite, covellite, malachite	banded, disseminated
579	Ted's Group Prospect	004			Middle Fork (east of PNF)	W		vein
636	White Metal Prospect	004	005		Edwardsburg	W	huebnerite, scheelite	vein, stockwork
395	Mc Rae Mine	005	004		Edwardsburg	W	huebnerite, scheelite, powellite, pyrite, tetrahedrite?	vein/shear zone, stockwork
420	Morning Star Tungsten Claims Prospect	005	001	002	Edwardsburg	W	huebnerite, wolframite	vein, shear zone
493	Red Bluff Mine	005	004	002	Edwardsburg	W	huebnerite, scheelite, sphalerite, galena, chalcopyrite	vein, replacement
548	Snowbird Mine	005	004		Edwardsburg	W	huebnerite, scheelite, stolzite, chalcopyrite, tetrahedrite, sphalerite	vein, replacement, disseminated
57	Black Lake (Maid of Erin) Mine	007			Seven Devils	Au	native gold	vein/shear zone
95	Carbonate Hill Area Prospect	007			Crooks Coral	Au	gold	vein
143	Curren Mtn. Prospect	007			Mountain View	Au,Ag	pyrite, limonite	quartz vein
195	Freeze Prospect	007			Cuddy Mountain	Au	gold	vein
226	Gold Occurrence	007			north of Mineral	Au	native gold	vein
307	Imnaha Occurrence	007			Snake River (n. of w. PNF)	Au		vein/shear zone
432	Name Unknown Prospect	007			Unnamed (west of PNF)	Au, Ag		vein/shear zone
471	Placer Basin Mine	007			Seven Devils	Au	Au	vein
37	Bell Mine	009			Mineral (w. of PNF)	Ag, Ag	chalcopyrite, tetrahedrite, sphalerite, galena, copper sulfate	vein
38	Belmont Mine	009			Cuddy Mtn. (w. of PNF)	Ag, Zn, Pb	argentiferous galena, sphalerite	vein
55	Black Hawk Mine	009			Mineral (w. of PNF)	Ag, Cu	chalcopyrite, tetrahedrite, galena, sphalerite, wurtzite	vein
56	Black Jack Prospect	009			Mineral (w. of PNF)	Ag, Cu	sphalerite, chalcopyrite	vein
71	Boone Mine	009			Mineral (w. of PNF)	Ag, Cu	chalcopyrite, tetrahedrite, galena, sphalerite	vein
116	Con Dor Mine	009			Mineral (w. of PNF)		chalcopyrite, sphalerite, native gold	vein
174	Eagan Mine	009			Mineral (w. of PNF)	Ag, Cu	chalcopyrite, sphalerite, tetrahedrite, galena	replacement
179	Edna May Prospect	009			west of Cuddy Mountain	Pb, Cu	galena, pyrite, lead sulfosalt?	vein/shear zone
183	Enterprise Mine	009			Mineral (w. of PNF)	Ag, Cu	galena, sphalerite, chalcopyrite, tetrahedrite	vein
249	Grade Creek Prospect	009			Cuddy Mountain	Pb, Ag, Zn, Cu	galena, argentiferous galena, chalcopyrite, malachite, azurite, chrysocolla	vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
275	Hercules Group Prospect	009			Cuddy Mountain (w. of PNF)	Au, Ag, Cu, Pb, Zn	tetrahedrite, chalcopyrite, galena, sphalerite	stratiform, dissem, and vein
298	Houlahan Prospect	009			Cuddy Mtn. (w. of PNF)	Pb	galena	replacement
332	King Prospect	009			Mineral (w. of PNF)	Ag, Cu	chalcopyrite, sphalerite, and tetrahedrite	vein
346	Lead Zone Mine	009			west of Cuddy Mountain	Pb, Ag, Zn, Au	galena, anglesite, cerussite	vein
350	Liberty Mine	009			Mineral (w. of PNF)	Ag, Cu	chalcopyrite, sphalerite, tetrahedrite, galena	vein
388	Mariah Mine	009			Mineral (w. of PNF)	Ag, Cu, Au	chalcopyrite, tetrahedrite, galena, sphalerite, wurtzite	vein
393	Mc Curkle - Shane Mine	009			Mineral (w. of PNF)	Ag, Cu	chalcopyrite	replacement fissure veins
537	Silver Still Mine	009			Mineral (w. of PNF)	Ag, Au, Cu, Pb, Zn, Sn, Sb	chalcopyrite, galena, sphalerite, tetrahedrite, wurtzite, enargite, stannite	vein/fracture zone
584	Thor Property Occurrence	009			west of Cuddy Mountain	Ag, Pb, Zn		vein
17	Antz Creek Prospect	010	016		Seven Devils	Cu, Zn	tetrahedrite, malachite, azurite, sphalerite	vein/shear zone, replacement
21	Azurite Mine	010			Seven Devils	Cu, Pb, Zn	galena, chalcopyrite, sphalerite, tetrahedrite	vein
27	Ballard Group Mine	010	016		Homestead	Cu	chalcopyrite, malachite, azurite, pyrite	shear zone, replacement
77	Brooklyn Group Prospect	010			Homestead (west of PNF)	Cu, Ag, Au	chalcopyrite, azurite, bornite, chalcocite	vein/shear zone
94	Cap. Miller Mine	010	016		Homestead (west of PNF)	Cu	chalcocite	vein, replacement
110	Cliff Prospect	010			Hells Canyon (undefined)	Cu, Ag, Au	bornite, chalcopyrite, chalcocite, covellite, free gold	vein
114	Cole Occurrence	010	016		Homestead (west of PNF)	Cu	chalcopyrite	vein, replacement
134	Cracker Jack Prospect	010			Seven Devils	Cu	chalcopyrite	vein
168	Dove Creek Prospect	010			Homestead (west of PNF)	Cu		vein/shear zone
189	Farrell Group Occurrence	010	001		Homestead (west of PNF)	Cu		vein, replacement
197	Frenchy's Mine	010			Seven Devils	Cu, Au, Mo	chalcopyrite, native gold, molybdenite	vein
283	Hill Claims Occurrence	010			Homestead (west of PNF)	Cu		vein/shear zone
336	Koger Group Occurrence	010	016		Homestead (west of PNF)	Cu	pyrite	veins, replacement
353	Lime Peak Prospect	010	016		Seven Devils	Cu	chalcocite, malachite, azurite, chalcopyrite	vein/disseminated?, replacement
377	Lucky Strike Prospect	010			Seven Devils	Cu, Ag	chalcopyrite, chalcocite, covellite, malachite, chrysocolla, azurite,	vein
381	Mac Dougall Group Prospect	010	016		Homestead (west of PNF)	Cu	chalcopyrite; pyrite, chalcocite, bornite, chrysocolla, limonite	veins, replacement
459	Panama Pacific Claims Prospect	010			Seven Devils	Cu, Ag	bornite, chalcopyrite, malachite, chrysocolla, azurite	pegmatite with bn-cp pods
486	Rand-Mc Carthy Mine	010	016		Homestead (west of PNF)	Au, Cu, Ag	chalcopyrite, malachite , pyrite	mineralized shear zone, replacement

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
498	Red Mound	010			Homestead (west of PNF)	Cu, Ag, Pb, Zn	chalcopyrite, sphalerite, malachite, azurite, pyrite	vein/shear zone, replacement
509	River Queen Mine	010			Seven Devils	Cu, Ag, Au	chalcopyrite, bornite, covellite, tetrahedrite, cuprite, malachite, azurite	vein
513	Rogers Group Occurrence	010	016		Homestead (west of PNF)	Cu		shear zone, replacement
586	Thorne Flat Prospect	010	016		Homestead (west of PNF)	Cu	chalcopyrite, pyrite	vein, replacement
608	unnamed prospect	010			Seven Devils	Cu?		vein
609	unnamed prospect	010			Seven Devils	Cu	chalcopyrite, gold?	vein
79	Brownlee Manganese Prospect	011			Cambridge (west of PNF)	Mn	pyrolusite	vein
86	Burnt Rock Occurrence	011			Tamarack (undefined, West Mtns.)	Mn	manganese oxide	vein
316	J. G. Hill Occurrence	011			Mineral	Mn	black manganese oxides	vein
437	New Meadows Manganese Occurrence	011			New Meadows (undefined)	Mn		vein/disseminated
502	Reilly Manganese Deposits Prospect	011			Unnamed (e. of s. PNF)	Mn	manganese oxides	vein
564	Sturgill Creek Mine	011			Sturgill Cr. (w. of sw. PNF)	Mn	pyrolusite	vein
30	Barite Occurrence	012			Big Creek	Ba	chalcopyrite, malachite, barite	vein
311	Inspiration Barite Occurrence	012			Cuddy Mountain	Ba	barium	vein
444	North Hornet Mine (Peck Mountain prospect)	012			Unnamed (w. of Hornet Cr.)	Au, Ba	barite, pyrite, gold	stratiform layers and stratabound veins
507	Riley Prospect	012			Unnamed (west of Cuddy Mtn.)	Ag, Ba	native and wire silver	vein
43	Big Chief Claims Occurrence	013	001		Indian Creek (s. of e. PNF)	Ag, Au, Cu, Pb		vein
315	IXL Mine	013			Cuddy Mountain	Cu, Mo, Au, Ag	chalcopyrite, bornite, molybdenite	disseminated
319	Jerico Claim Occurrence	013	001		Indian Creek (s. of e. PNF)	Au, Cu, Mo		vein, disseminated
334	Kismet Prospect	013			Cuddy Mountain	Cu, Mo, Pb, Zn, Ag, Au	chalcopyrite, molybdenite	intrusive breccia
585	Thorn Spring Occurrence	013			Mineral (west of PNF)	Cu, Mo, Zn	chalcopyrite, malachite, azurite, sphalerite	disseminated
621	Vesper Claim Occurrence	013	001		Indian Creek (s. of e. PNF)	Ag, Au, Cu, Mo		vein, disseminated
9	Alaska Mine	014			Seven Devils	Cu, Mo, W	molybdenum-rich scheelite, powellite, azurite, bornite	skarn
18	Arkansaw Mine	014			Seven Devils	Cu	chalcopyrite, chrysocolla, cuprite, chalcocite, covellite, bornite, malachite	contact metamorphic
39	Benson Occurrence	014	001		Warren	Mo	molybdenite, pyrrhotite	skarn, disseminated
63	Blue Jacket Mine	014			Seven Devils	Cu, Ag, Au	chalcopyrite, bornite, chalcocite, argentite, tetrahedrite, covellite,	skarn
90	California Prospect	014			Seven Devils	Cu	chalcopyrite?, malachite	skarn

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
91	Calumet Prospect	014			Seven Devils	Cu	chalcopyrite, chrysocolla, chalcocite, covellite	contact metamorphic
122	Copper Cliff Occurrence	014			Edwardsburg	Cu	chalcopyrite	vein
126	Copper Mountain Prospect	014	027		Indian Creek (south of PNF)	Cu, W, Ag		contact metamorphic (dike and limestone)
167	Douglass Prospect	014			Seven Devils	Cu	copper sulfides	contact metamorphic
210	Glasgow-Green Occurrence	014			Seven Devils	Cu	chalcopyrite, malachite	skarn
248	Goodrich Creek Canyon Prospect	014			Cuddy Mountain	Cu	chalcopyrite, malachite, azurite	contact metamorphic (skarn?)
251	Granite Queen Prospect	014			West Mtns. (undefined)	Cu	chalcopyrite, malachite, chalcocite	skarn
271	Helena Mine	014			Seven Devils	Cu, Au, Ag, Mo, W	bornite, lindgrenite, scheelite, powellite, cuprotungstite.	contact metamorphic
300	Humboldt Prospect	014			Seven Devils	Cu	copper sulfides	contact metamorphic
364	Lockwood Mine	014			Seven Devils	Cu, Ag, W, Mo	scheelite - powellite, bornite, malachite, chrysocolla, molybdenite	contact metamorphic
407	Missouri Creek Group Prospect	014			Edwardsburg	Cu	chalcopyrite	replacement
448	O'Leary's Prospect	014			Seven Devils	Cu	copper sulfides	contact metamorphic
462	Patton Occurrence	014			Seven Devils	Mo, W	scheelite, molybdenum	contact metasomatic
464	Peacock Mine	014			Seven Devils	Cu, Ag, Au	bornite, chrysocolla, malachite, azurite, cuprite, chalcocite, covellite	Skarn
483	Queen Mine	014			Seven Devils	Cu, Ag, Au	chalcopyrite, chalcocite, covellite, bornite, malachite, cuprite, native copper	contact metamorphic
484	Railroad Mine	014			Cuddy Mountain (Heath subdist.)	Cu, Ag, Au	chalcopyrite, bornite	Skarn
517	Rush Peak Copper Occurrence	014			Cuddy Mountain	Cu	malachite, azurite, chalcopyrite	replacement, skarn?
539	Skarn Prospect	014			Mineral	Cu	chalcopyrite, malachite	skarn
556	South Peacock Mine	014			Seven Devils	Cu	bornite, chalcopyrite, covellite, cuprite, chrysocolla, malachite, chalcocite	skarn
595	Tussel Mine	014			Seven Devils	Cu, Au, Ag	bornite, malachite, scheelite, powellite, molybdenite, lindgrenite	skarn
638	White Monument Mine	014			Seven Devils	Cu, Ag, Au	chalcopyrite, malachite	skarn
641	Wild Horse Copper Prospect	014			Big Creek	Cu	chalcopyrite, malachite	metamorphic
2	Abundance Mine	015			Mineral (Iron Mtn. subdist.)	Fe, Cu	crystalline hematite, sulfides	residual weathering
93	Campbell Magnetite Mine	015			Mineral (Iron Mtn. subdist.)	Fe, Cu	magnetite, hematite , chalcopyrite	Skarn
111	Climax Prospect	015			Cuddy Mountain	Cu, Ag	chalcopyrite	contact metasomatic
314	Iron Prospect	015			Cuddy Mountain	Cu, Fe	pyrite, chalcopyrite, magnetite, specular hematite	contact metasomatic

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
399	Metheny Prospect	015			Cuddy Mountain	Cu	copper-stained material	replacement
412	Montana Prospect	015			Mineral (Iron Mtn. subdist.)	Fe, Cu	magnetite, hematite, chalcopyrite	skarn
421	Mortimer Prospect	015			Mineral (Iron Mtn. subdist.)	Fe, Cu	magnetite, chalcopyrite	Skarn
559	Standard Specularite Prospect	015			Mineral (Iron Mtn. subdist.)	Fe	hematite, specular hematite , malachite?	replacement
605	unnamed prospect	015			Cuddy Mountain	Fe, Cu	magnetite, specular hematite, pyrite, chalcopyrite, malachite	skarn
1	1905 Mine	016			Seven Devils	Cu	chalcocite, bornite, tetrahedrite, malachite, azurite, cuprite.	replacement
11	Allison Creek Occurrence	016			Seven Devils	Cu	chalcocite, azurite, malachite	disseminated
26	Badger Mine	016			Seven Devils	Cu, Ag, Au	chalcocite, tetrahedrite, bornite	replacement
123	Copper Cliff Mine	016			Seven Devils	Cu, Ag	chalcopyrite, bornite, ruby silvers, chalcocite, malachite, chrysocolla	stratabound
127	Copper Occurrence	016			Seven Devils	Cu	chalcocite, bornite, chalcopyrite, native copper, cuprite, azurite, malachite	stratabound
177	East Fork of Mann Creek Occurrence	016			Mineral	Cu		disseminated ?
178	Eckels Creek Stock Occurrence	016			Seven Devils	Cu, Zn	chalcopyrite, chalcocite, bornite, sphalerite	disseminated
297	Horse Mountain Occurrence	016			Seven Devils	Cu	chalcocite, bornite, malachite	stratabound
380	Lynes Occurrence	016			Seven Devils	Cu	bornite, chalcocite, azurite, malachite	stratabound
385	Mann Creek Occurrence	016			Seven Devils	Cu, Zn	chalcopyrite, bornite, chalcocite, sphalerite, chrysocolla, azurite, malachite	stratabound
500	Red Wing Occurrence	016			Seven Devils	Cu	chalcocite, bornite, tetrahedrite, malachite, azurite, cuprite	replacement
593	Transfer Point Occurrence	016			Seven Devils	Cu	chalcocite, bornite, azurite, malachite, chrysocolla	stratabound
643	Wilford Prospect	016			Seven Devils	Cu, Zn	chalcocite, chalcopyrite, bornite, sphalerite, azurite, malachite, chrysocolla	stratabound
645	Windy Ridge Occurrence	016			Seven Devils	Cu	chalcocite, bornite, malachite, azurite	disseminated
294	Hornet Creek Prospect	017			Hornet Creek	Cu, Au, Ag	chalcopyrite	dissem., replacement
313	Iron Dyke Mine	017			Homestead (west of PNF)	Cu,Au,Ag	chalcopyrite, pyrite	layered, brecciated, stockwork, and replacement
392	Mc Carty Mine	017			Homestead (undefined)	Zn, Cu, Pb, Au, Ag	bornite, sphalerite, galena, malachite, azurite, chalcopyrite	vein
494	Red Ledge No. 30	017			Homestead (undefined)	Cu	chalcopyrite	vein

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
496	Red Ledge Prospect	017			Homestead (undefined)	Cu, Pb, Zn, Ag, Au	chalcopyrite, galena, sphalerite, chrysocolla, bornite, tetrahedrite,	volcanogenic massive sulfide
583	Thomas Heady Prospect	017			Homestead (undefined)	Cu, Pb, Zn	chalcopyrite, galena, sphalerite	disseminated
8	Advance Prospect	018			Thunder Mountain	Au, Ag		vein
42	Big Buck Prospect	018			Thunder Mountain	Au, Ag		vein
45	Big Duluth Prospect	018			Thunder Mountain	Au		vein
51	Bill Timm Prospect	018			Thunder Mountain	Au, Ag		vein
60	Blanche E Prospect	018			Thunder Mountain	Au, Ag		vein
65	Bluebird Prospect	018			Thunder Mountain	Au, Ag		vein
68	Bold Ruler Prospect	018			Thunder Mountain	Au, Ag		vein
74	Boulder Creek Occurrence	018			Thunder Mountain	Au		vein
83	Buffalo Group Prospect	018			Thunder Mountain	Au		vein
85	Bullion Prospect	018			Thunder Mountain	Au, Ag		vein
98	Catherine Lake Prospect	018			Big Creek	Au, Ag		vein
100	Century Prospect	018			Thunder Mountain	Au, Ag		vein
104	Cheapman - Wanderer Prospect	018			Thunder Mountain	Au, Ag		vein
105	Chief Executive Group Occurrence	018			Indian Creek (south of east PNF)	Au		vein
112	Climax Prospect	018			Thunder Mountain	Au		vein
117	Consolidation Occurrence	018			Thunder Mountain	Au		vein
118	Coone Creek Occurrence	018			Thunder Mountain	Ag, Au		vein, stratabound?
142	Cumberland Prospect	018			Thunder Mountain	Au, Ag		vein
153	Dewey Mine	018			Thunder Mountain	Au, Ag	electrum, pyrargyrite, anatase	vein, dissem., placer
161	Doctor Prospect	018			Thunder Mountain	Au		vein
184	Ethal B. Occurrence	018			Thunder Mountain	Au, Ag		vein
185	Eureka Occurrence	018			Thunder Mountain	Au		vein
186	Evenstone Occurrence	018			Thunder Mountain	Au, Ag		vein
207	Giant Legge Group Occurrence	018			Marble Creek (s. of e. PNF)	Au, Ag		disseminated
216	Gold Cord Group Prospect	018			Marble Creek (s. of e. PNF)	Au, Ag		disseminated
218	Gold Dike Prospect	018			Thunder Mountain	Ag		disseminated
224	Gold Lodge Claim Prospect	018			Big Creek	Au, Ag	gold, sulfides	shear zone
225	Gold Nugget Prospect	018			Thunder Mountain	Ag		vein
233	Golden Chimney Prospect	018			Thunder Mountain	Au, Ag		vein
234	Golden Coin Group Prospect	018			Thunder Mountain	Ag, Au		vein
238	Golden Giant Prospect	018			Thunder Mountain	Au	gold	vein
254	Green Goode Occurrence	018			Thunder Mountain	Au		vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
261	H - Y Prospect	018			Thunder Mountain	Au, Ag		vein
274	Hercules Group Prospect	018			Marble Creek (s. of e. PNF)	Au, Ag		disseminated
282	Highland Claim Occurrence	018			Big Creek	Au, Ag		vein
287	Hold Out Occurrence	018			Thunder Mountain	Ag		disseminated
293	Hope Claim Occurrence	018			Marble Creek (s. of e. PNF)	Au, Ag		disseminated
302	Hurricane Eagle Prospect	018			Thunder Mountain	Au, Ag		vein
304	Ibex Claim Occurrence	018			Thunder Mountain	Au, Ag		disseminated
310	Independence Prospect	018			Thunder Mountain	Au		vein
320	Jerome Group Occurrence	018			Marble Creek (s. of e. PNF)	Au, Ag		vein
326	Jumbo Prospect	018			Thunder Mountain	Au, Ag		vein
337	L. S. No. 1 Claim Prospect	018			Big Creek	Au, Ag		vein
342	Lark Occurrence	018			Thunder Mountain	Ag		disseminated
355	Lion Prospect	018			Thunder Mountain	Au, Ag		vein
356	Little Cottonwood Creek Prospect	018			Marble Creek (s. of e. PNF)	Au, Ag		disseminated
360	Little Joe Occurrence	018			Thunder Mountain	Ag		disseminated
404	Milk Lake Prospect Occurrence	018			Big Creek	Au, Ag		replacement
405	Minerva Group Prospect	018			Thunder Mountain	Ag		disseminated
409	Mollie Prospect	018			Thunder Mountain	Au		vein
419	Morning Occurrence	018			Thunder Mountain	Ag		disseminated
428	Mule Creek Prospect	018			Thunder Mountain	Au, Ag		vein
431	Murphy Peak Prospect	018			Indian Creek (s. of e. PNF)	Au, Ag		vein
436	New Hope Mine	018			Thunder Mountain	Au, Ag		vein
438	Nice Boy Occurrence	018			Thunder Mountain	Au		vein
443	North Fork Occurrence	018			Thunder Mountain	Ag		vein
442	North Fork Of West Fork Occurrence	018			Big Creek	Au, Ag		vein
460	Panhandle Group Prospect	018			Thunder Mountain	Ag		disseminated
463	Payboy Group Prospect	018			Thunder Mountain	Au, Ag		vein
466	Pearl Occurrence	018			Thunder Mountain	Ag		disseminated
467	Pearl Prospect	018			Thunder Mountain	Au, Ag		vein
469	Phonolite Group Prospect	018			Thunder Mountain	Au, Ag		vein
481	Pyramid Prospect Occurrence	018			Thunder Mountain	Au, Ag		vein
491	Red Bird Prospect	018			Thunder Mountain	Au, Ag		vein
492	Red Bluff Group	018			Thunder Mountain	Au, Ag		vein
508	Rising Star Prospect	018			Thunder Mountain	Au		vein
520	Safety Creek Occurrence	018			Thunder Mountain	Au		vein
529	Short Line Prospect	018			Thunder Mountain	Au, Ag		vein
540	Skookum Claim Prospect	018			Big Creek	Au, Ag		vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
558	Standard Mine	018			Thunder Mountain	Au, Ag		vein
573	Sunnyside Mine	018			Thunder Mountain	Au, Ag	electrum	vein
577	Talc Creek Prospect	018			Big Creek	Au		vein
580	Tempiute Prospect	018			Thunder Mountain	Au, Ag		vein
582	Terrible Teddy Prospect	018			Thunder Mountain	Au, Ag		vein
589	Three Mile Prospect	018			Thunder Mountain	Ag		disseminated
590	Thunderation Group Occurrence	018			Thunder Mountain	Au, Ag		disseminated
597	Twentieth Century Group Prospect	018			Thunder Mountain	Au, Ag		vein ?
616	Valentine Claim Prospect	018			Big Creek	Au, Ag	gold, sulfides	disseminated
619	Venable Mine	018			Thunder Mountain	Au, Ag	electrum?, limonite?	vein
624	W. K. No. 1 Claim Prospect	018			Big Creek	Au, Ag	opal	vein
72	Bostic Occurrence	019			Resort	Hg, Sb	cinnabar	veinlets
82	Bucks Bed Prospect	019			Yellow Pine	Hg	cinnabar	vein
190	Fern Mine	019			Yellow Pine	Hg	cinnabar	chalcedony veins, disseminated
262	H. T. Abstein's Prospect	019			Yellow Pine	Hg	cinnabar	vein
273	Hennessey Prospect	019	003		Yellow Pine	Hg, Sb	cinnabar, stibnite	vein, replacement
277	Hermes Mine	019			Yellow Pine	Hg	cinnabar, stibnite, realgar, orpiment, pyrite, arsenopyrite, electrum	fracture filling
424	Mountain Chief Prospect	019			Yellow Pine	Hg, Sb	cinnabar, galena	vein
546	Smith Prospect	019			Yellow Pine	Hg	cinnabar	replacement vein
620	Vermillion Mine	019			Yellow Pine	Hg	cinnabar	fracture filling
623	Virginia L. Claims Mine	019			Weiser (w. of sw. PNF)	Hg	cinnabar	vein
637	White Metal Prospect	019			Yellow Pine	Hg, Sb	stibnite, cinnabar	replacement vein
34	Bear Trap Occurrence	020			Big Creek	opal	opal	vein
253	Grays Peak Opal Prospect	020			Marble Creek (s. of e. PNF)	opal	opal	vein
329	Ketchum Claim Occurrence	020			Big Creek	silica	opal	vein
413	Monument Occurrence	020			Big Creek	opal	opal	vein
501	Redridge Group Mine	020			Big Creek	opal	opal	vein
139	Crystal Mountain Quartz Quarry Mine	021			Resort	quartz	quartz	pegmatite
247	Goodenough Prospect	021			West Mtns. (undefined)	quartz	quartz crystals	pegmatite
288	Hollenbeat Quartz Occurrence	021			Riggins (north of west PNF	silica	quartz	vein
317	Jacobs Occurrence	021			Cougar Creek (undefined)	silica	quartz	vein
530	Silica Prospect	021			Mineral	silica	quartz	pegmatite
108	Clark Occurrences	022			west of Meadows	mica	mica (iron-stained)	pegmatite

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
150	Deer Ridge Occurrence	022			Riggins (north of PNF)	sheet mica	mica books	pegmatite
281	Hidden Fawn Occurrence	022			Riggins (north of PNF)	sheet mica, scrap mica	muscovite books	pegmatite
401	Mica Queen Mine	022			West Mtns. (undefined)	sheet mica, feldspar, flake mica	feldspar, sheet mica, mica books	pegmatite
449	O. K. Occurrence	022			Riggins (undefined)	sheet mica	book mica	pegmatite
562	Stites Prospect	022			West Mountains (undefined	feldspar, mica	feldspar, muscovite	pegmatite
260	Gypsum Mine	023			Mineral	gypsum	gypsum (anhydrite)	sedimentary
259	Gypsum Occurrence	023			Mineral	gypsum	gypsum (anhydrite)	sedimentary
12	Allison Ranch Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
19	Arlise Gulch Placer Mine	024	025		Warren	Au	gold	placer
29	Bargamin Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
31	Barth Hot Springs Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
32	Bear Creek Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
35	Beaver Creek Basin Placer Prospect	024	025		Ramey Ridge	Au	gold, black sands (mainly magnetite, ilmenite, apatite, ferromagnesian silicates)	placer
36	Beaver Creek Placer Prospect	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer
44	Big Creek Gold Mines Placer Prospect	024	025		Edwardsburg	Au	gold	placer
47	Big Mallard Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
48	Big Ramey Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer
58	Black Sand Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
66	Boise Bar Placer Mine	024	025	026	Dixie (north of PNF)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
70	Bonanza Placer Occurrence	024	025		Marble Creek (s. of e. PNF)	Au	gold, black sands	placer
73	Boulder Creek Placer Occurrence	024			Ramey Ridge	Au	gold	placer
80	Bruin Creek Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
81	Buck Placer Mine	024	025		Warren	Au	gold	placer
87	Burris Placer Mine	024	025		Big Creek	Au	gold, black sands	placer
88	Buttercup Group Placer Mine	024			Florence (north of PNF)	Au, peat	native gold , peat	placer

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
89	Cabin Creek Bar Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
96	Carpenters Gulch Placer Occurrence	024	025		Ramey Ridge	Au	gold; black sands (mainly ilmenite, magnetite)	placer
97	Carrick Diggings Placer Mine	024			Seven Devils	Au	free gold	placer
99	Cave Creek Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
101	Chamberlain Meadow Placer Prospect	024	025	026	Chamberlain Basin	Au, REE	zircon, allanite, cinnabar, magnetite, ilmenite (black sands), gold	placer
102	Charity Gulch Placer Mine	024	026		Warren	Au, Th?	gold, monazite	placer
113	Cold Meadows Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands	placer
119	Copper Camp Flat Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer
124	Copper Creek Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer
129	Cory Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
131	Cougar Creek Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
132	Coxey Creek Bar Placer Occurrence	024	025		Big Creek	Au	gold, black sands (ilmenite, magnetite)	placer
133	Coxey Creek Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
135	Crane Meadows Placer Prospect	024	025	026	Ramey Ridge	Au	gold, black sands (magnetite, allanite, ilmenite, zircon)	placer
137	Crooked Creek Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mostly ilmenite, magnetite)	placer
138	Crossing Bar Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer
141	Culver Creek Placer Occurrence	024			Paddy Flats (undefined)	Au		placer
147	Daylight And Darkness Placer Prospect	024	025		Marble Creek (s. of e. PNF)	Au	gold, black sands	placer
157	Dillinger Meadows Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands	placer
158	Disappointment Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
162	Dodger Placer North Occurrence	024	025		South Fork Salmon (undefined)	Au, Ti, Fe	magnetite, ilmenite (black sands), gold	placer

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
163	Dodger Placer South Occurrence	024	025		South Fork Salmon (undefined)	Au	magnetite, ilmenite (black sands), gold	placer
169	Dovel Placer Mine	024	025		Big Creek	Au	ilmenite, zircon, magnetite (black sands), gold	placer
172	Dynamite Placer Occurrence	024	025		Marble Creek (s. of e. PNF)	Au	gold, black sands	placer
180	Elkhorn Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
187	Excelsior Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
188	Fall Creek Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer
191	Fisher And Baumhoff Placer Mine	024			Warren	Au	gold	placer
196	French Creek Placer Mine	024			Riggins (north of west PNF	Au	fine gold	placer
199	Gaines Bar Placer Mine	024	025	026	Dixie (north of PNF)	Au, garnet, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
204	Gayety Placer Mine	024			Warren	Au	gold	placer
206	Gayhart Burns Placer Mine	024			Resort	Au	gold	placer
211	Goat Creek Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
220	Gold Dust Sonny Placer Mine	024	025		Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
222	Gold Hill Group Occurrence	024			Edwardsburg	Au	gold	placer
240	Golden Rule Placer Mine	024	025	026	Marble Creek (s. of e. PNF)	Au, Th, Ti, REE	monazite, thorium, garnet, sapphire, titanium, zirconium, ilmenite	placer
241	Golden Rule Placer Mine	024			Resort	Au, Ag		placer
252	Grassy Flat Placer Occurrence	024	025		Big Creek	Au	gold, black sands (mainly magnetite, ilmenite, ferromagnesian silicates)	placer
257	Groundhog Bar Placer Mine	024	025		Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
263	Halls Gulch Placer Mine	024			Warren	Au	gold	placer
265	Hand Meadows Placer Prospect	024	025	026	Ramey Ridge	Au	gold, black sands (magnetite, allanite, ilmenite, zircon)	placer
267	Hard Boil Bar Placer Occurrence	024	025		Big Creek	Au	ilmenite, gold, magnetite (black sands)	placer
269	Haypress Meadow Placer Prospect	024	025	026	Chamberlain Basin	Au, REE	zircon, allanite, cinnabar, ilmenite, magnetite (black sands), gold	placer
270	Healy Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
278	Hermit Hanks Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
292	Hoodoo Creek Placer Mine	024	025		Warren	Au	gold	placer

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
296	Horse Creek and Horse Bar Placer Mines	024	025	026	Salmon River (undefined)	Au, Fe, garnet, monazite, Ti, Zr	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
299	Huddleson Placer Occurrence	024	025		South Fork Salmon (undefined)	Au	magnetite, ilmenite (black sands), gold	placer
301	Huntz Gulch Bar Placer Occurrence	024	025	026	Marshall Lake	Au, monazite, garnet	black sands concentrate	placer
306	Idaho Klondike Placer Mine	024			Marshall Lake	Au		placer
322	John Vine Bar Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
324	Julie Creek Bar Placer Occurrence	024	025		Salmon River	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
330	Keystone Meadows Placer Prospect	024	025		Warren	Au	gold	placer
339	Lake Creek Placer Mine	024			Resort	Au		placer
341	Lantz Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
347	Lemhi Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
351	Lily Of The Valley Placer Mine	024			Florence	Au	native gold	placer
357	Little Cow Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
361	Little Marble Creek Placer Prospect	024	025		Edwardsburg	Au	gold, black sands	placer
362	Little Ramey Placer Occurrence	024	025		Ramey Ridge	Au	gold; black sands (mainly ilmenite, magnetite)	placer
367	Lost Meadows And Bitterroot Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
375	Lucky Boy Placer Occurrence	024			Indian Creek (s. of e. PNF)	Au, Ag		placer
386	Marble Creek Placer Prospect	024	025		Thunder Mountain	Au	gold, black sands	placer
389	Martinace Meadows Placer Prospect	024			Warren	Au	gold	placer
394	Mc Govern And Hackney Placer Mine	024			Warren	Au	gold	placer
397	Meadow Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
400	Meyers Creek Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
403	Mile Flat Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite, gold (black sands)	placer
414	Monumental Bar Placer Occurrence	024	025		Ramey Ridge	Au	gold, black sands (mainly ilmenite, magnetite)	placer

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
415	Monumental Creek Ranch Placer Mine	024	025		Big Creek	Au	magnetite, ilmenite, zircon (black sands), gold	placer
417	Moore Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
425	Mountain Sheep Placer Occurrence	024	025		South Fork Salmon (undefined)	Au	magnetite, ilmenite (black sands), gold	placer
426	Mountain View Placer Occurrence	024	025		Marble Creek (s. of e. PNF)	Au	gold, black sands	placer
439	Nixon Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
441	No Name Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
447	Nugget Creek Placer Occurrence	024	025		Middle Fork (east of PNF)	Au	gold, black sands (mainly magnetite, ilmenite, ferromagnesian silicates)	placer
453	Olson's Placer Mine	024			Connor Cr. (west of PNF)	Au, Ag		placer
455	Over Easy Bar Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
457	Painter Bar Placer Mine	024	025		Dixie (north of PNF)	Au	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
461	Parrot Camp Placer Occurrence	024	025		Middle Fork (east of PNF)	Au	gold, black sands (mainly magnetite, ilmenite, ferromagnesian silicates)	placer
465	Pearl Placer Mine	024	025		Warren	Au	gold	placer
473	Point Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
488	Rattlesnake Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
505	Richardson Creek Bar Placer Occurrence	024	025		Salmon River (undefined)	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates	placer
511	Rock Flat Placer Mine	024	026	047	Meadows	Au, garnet, monazite, gems	corundum, sapphires, garnet, monazite, zircon, ilmenite, diamond	placer, vein
516	Ruby Creek Placer Mine	024	025	026	Resort	Au, monazite	monazite, cinnabar, gold	placer
521	Salmon Placer North Occurrence	024	025		South Fork Salmon (undefined)	Au	magnetite, ilmenite (black sands), gold	placer
522	Salmon Placer South Occurrence	024	025		South Fork Salmon (undefined)	Au	magnetite, ilmenite (black sands), gold	placer
523	Sand Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
524	Schissler Creek Placer Mine	024	025		Warren	Au	gold	placer
526	Secesh - Ruby Placers Mine	024	025	026	Resort	Au, monazite	gold, magnetite, ilmenite, garnet, zircon, monazit	placer
538	Simmons Placer Mine	024			Big Creek	Au	gold	placer
541	Slaughter Creek Placer Mine	024			Warren	Au	gold	placer

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
543	Smith Creek Hydraulic Co. Placer Mine	024	025		Edwardsburg	Au	gold, black sands (mainly magnetite and ferromagnesian silicates), staurolite	placer
544	Smith Creek Placer Mines	024	026		Warren	Au, monazite	gold, amalgam, monazite	placer
545	Smith Gulch Bar Placer Mine	024	025	026	Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
554	Soft Boil Bar Placer Occurrence	024	025		Big Creek	Au	ilmenite, magnetite (black sands), gold	placer
555	South Fork Placer Mine	024			Warren	Au		placer
560	Steamboat Creek Placer Mine	024			Warren	Au	gold	placer
565	Sturgill Creek Placer Mine	024			Sturgill Cr. (w. of sw. PNF)	Au	gold	placer
569	Summit Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
574	Survey Creek Bar Placer Occurrence	024	025		Middle Fork (east of PNF)	Au	gold, black sands (mainly magnetite, ilmenite, ferromagnesian silicates)	placer
575	Survey Creek Placer Occurrence	024	025		Middle Fork (east of PNF)	Au	gold, black sands (magnetite, ilmenite, ferromagnesian silicates)	placer
587	Thorpe Placer Mine	024	025	026	Resort	Au, garnet, monazite	magnetite, garnet, zircon, monazite, corundum, rutile, cinnabar, ilmenite	placer
588	Three Mile Creek Placer Mine	024	025	026	Resort	Au, garnet, monazite	corundum, garnet, ilmenite, zircon, monazite (black sands), gold	placer
615	Upper Ramey Meadows Placer Occurrence	024	025	026	Ramey Ridge	Au, REE	gold, black sands (magnetite, ilmenite, allanite, zircon)	placer
628	Warren Meadows Placer Mine	024	025		Warren	Au, Ag	zircon, garnet, gold	placer
631	Webfoot Creek Placer Mine	024			Warren	Au	gold	placer
635	West Fork Monumental Creek Placer Prospect	024			Thunder Mountain	Au		placer
639	White Sand Creek Placer Mine	024			Florence (north of PNF)	Au	native gold	placer
640	Widow Bar Placer Occurrence	024	025		Salmon River	Au	gold, black sands (mainly magnetite, ilmenite, sphene, ferromagnesian silicates)	placer
650	Woolard Creek Placer Occurrence	024	025		Middle Fork (east of PNF)	Au	gold, black sands (mainly magnetite, ilmenite, ferromagnesian silicates)	placer
653	Yellow Pine Bar Placer Mine	024	025		Salmon River (undefined)	Au, monazite	magnetite, ilmenite, zircon, ferromagnesian silicates, rutile, sphene	placer
221	Gold Fork Placer Prospect	025			Donnelly (undefined)	Ti	black sands, ilmenite	placer
258	Grouse Creek Placer Occurrence	025			Florence (northof PNF)	U	uranium	placer
510	Robbins Creek Placer Occurrence	025			Florence (north of PNF)	U	uranium	placer

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
365	Lodgepole Meadow Placer Prospect	026	025		Chamberlain Basin	REE	zircon, allanite, cinnabar, ilmenite, magnetite (black sands)	placer
372	Lower Ramey Meadows Placer Occurrence	026	025		Ramey Ridge	REE	black sands (magnetite, allanite, zircon, ilmenite)	placer
418	Moose Meadow Placer Occurrence	026	025		Chamberlain Basin	REE	zircon, allanite, cinnabar, ilmenite, magnetite (black sands)	placer
456	Paddy Flat Placer Prospect	026	025		Paddy Flat (undefined)	monazite, Nb, Ta	monazite, columbite-tantalite	placer
514	Root Ranch Placer Occurrence	026	025		Chamberlain Basin	REE	black sands (zircon, allanite, ilmenite, magnetite, cinnabar)	placer
450	Oberbillig Prospect	027			Yellow Pine	W	scheelite	tactite stringer
470	Pioneer Group Prospect	027	003	004	Yellow Pine	Sb, W	stibnite, scheelite	vein, shear zone, disseminated
479	Profile Gap Prospect	027	014		Profile	W	scheelite, molybdenite, chalcopyrite	stratabound, contact metamorphic
576	Syringa Occurrence	027			Profile	W	scheelite	contact metamorphic
416	Monumental Summit Rare-earth Prospect	029			Thunder Mountain	Ce, Y, REE, Mn	rhabdophane, cinnabar, monazite, zircon	vein
487	Rare Earth Occurrence	029			Yellow Pine	REE, Ce, Hg, monazite, Zr	rhabdophane, cinnabar, monazite, zircon	shear zone
533	Silver Cliff Lode Prospect	031			Yellow Pine	Sb, Ag	antimony sulfide, copper sulfide	replacement
3	Acorn Butte No. 1 Occurrence	033			Ramey Ridge	Au, Ag, Cu	chalcopyrite, malachite	vein
4	Acorn Butte No. 2 Occurrence	033			Ramey Ridge	Au, Ag	chalcopyrite, malachite	vein
5	Acorn Butte No. 3 Prospect	033			Ramey Ridge	Au, Cu, Ag	chalcopyrite, malachite	vein
6	Acorn Butte No. 4 Occurrence	033			Ramey Ridge	Au, Cu, Ag	chalcopyrite, malachite	vein
7	Acorn Group Prospect	033			Big Creek	Au, Ag	gold, sulfides	vein
24	B. J. Occurrence	033			Ramey Ridge	Au	gold	vein
25	Badger Prospect	033			Ramey Ridge	Au	gold	vein
40	Betty Jane Claim Occurrence	033			Ramey Ridge	Ag, Cu	chalcopyrite, malachite	vein
46	Big Horn Prospect	033			Big Creek	Au, Ag, Cu	malachite	vein
50	Big Sunflower No. 1 Prospect	033			Ramey Ridge	Cu, Au, Ag	malachite	vein
52	Black and White Claim Prospect	033			Ramey Ridge	Cu, Au, Ag	sulfides	vein
75	Box Springs Claim Prospect	033			Big Creek	Cu, Au, Ag	chalcopyrite, bornite	vein
78	Brown Bear Occurrence	033			Ramey Ridge	Ag, Au, Cu	chalcopyrite, malachite	vein
120	Copper Camp Prospect	033	024		Ramey Ridge	Cu, Au, Ag	chalcopyrite, chalcocite, malachite, gold, silver, black sands	vein, placer
121	Copper Clad Group Prospect	033			Big Creek	Cu	chalcopyrite, malachite, chrysocolla	shear zone
128	Copper Prospect	033			Big Creek	Cu	chalcopyrite	vein
148	Deckie Prospect	033			Big Creek	Au, Ag, Cu		vein
149	Deer Creek Prospect	033			Big Creek	Cu		shear zone

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

Appendix B. Mineral localities of Payette NF and vicinity, sorted by deposit-type

map		Deposit Codes*						
no.	**Mineral Locality**	**dc1**	**dc2**	**dc3**	**Mining District**	**Commodity**	**Ore Minerals**	**Form of Deposit**
154	Dewey Moore Group Prospect	033			Big Creek	Au, Ag	chalcopyrite	vein
156	Diamond Creek Occurrence	033			Big Creek	Au		vein
192	Florence "A" Group Prospect	033			Ramey Ridge	Au, Ag	gold, silver	vein
201	Galena Prospect	033	001		Ramey Ridge	Pb, Cu, Au, Ag	galena, chalcopyrite, malachite, azurite, bornite	vein
212	Goat Haven Group Prospect	033			Big Creek	Cu, Au, Ag	malachite, chalcopyrite	shear planes
213	Gold Bug Cabin Prospect	033			Ramey Ridge	Au, Ag	gold, silver	vein
215	Gold Bug No. 5 Claim Prospect	033			Ramey Ridge	Au, Ag, Cu	chalcopyrite, malachite	vein
217	Gold Crown Group Prospect	033			Ramey Ridge	Au, Ag, Cu	chalcopyrite	vein
219	Gold Dollar Group Prospect	033			Ramey Ridge	Au, Cu	chalcopyrite	vein
227	Gold Reef Group Prospect	033			Ramey Ridge	Au, Ag, Cu	malachite	vein
230	Gold Slide Group Prospect	033			Ramey Ridge	Au, Ag	gold, silver	vein
232	Golden Bear Claims Prospect	033			Ramey Ridge	Cu, Au, Ag	malachite, chalcopyrite, cobalt	vein
244	Goldfield Group Occurrence	033			Ramey Ridge	Au, Ag, REE, Ti	gold	vein
255	Green Jacket Prospect	033			Big Creek	Cu, Au, Ag	malachite, chalcopyrite	vein
266	Happy Jack Prospect	033			Ramey Ridge	Au, Cu	chalcopyrite	vein
305	Idaho - Rainbow Group Prospect	033	001		Ramey Ridge	Cu, Au	chalcopyrite, malachite, galena	vein
318	Jensen Group Mine	033			Big Creek	Cu, Au, Ag	chalcopyrite, native gold	vein
321	Joe Deposit Prospect	033			Edwardsburg	Au, Ag	silver sulfides	vein
323	Johnson Lode Prospect	033			Middle Fork (east of PNF)	Au, Ag, Cu	chalcopyrite, malachite	vein
331	Kimmel Creek Prospect	033			Big Creek	Au, Ag, Cu		vein
344	Last Chance Claim Prospect	033			Ramey Ridge	Au, Ag	sulfides	vein
348	Lewiston Fraction Claim Occurrence	033			Ramey Ridge	Ag, Cu, Au	chalcopyrite	vein
352	Lime Creek Prospect	033			Big Creek	Au, Ag	gold, sulfides	vein
358	Little Gem No. 7 Mine	033			Ramey Ridge	Au, Ag, Cu, Pb, Zn, Mo	chalcopyrite	vein
370	Lower Iron Clad Claims Prospect	033			Big Creek	Cu, Au, Ag	chalcopyrite	fissure vein
371	Lower Kimmel Creek Prospect	033			Big Creek	Au, Ag, Cu	chalcopyrite, malachite	vein
373	Lower Survey Creek Prospect	033			Big Creek	Au, Ag, Cu	malachite	vein
379	Luzon Claim Occurrence	033			Ramey Ridge	Au, Cu	chalcopyrite	vein
383	Mahan Prospect	033			Ramey Ridge	Au, Cu, Ag	chalcopyrite, malachite	vein
387	Marble Creek Prospect	033			Edwardsburg	Au, Ag, Ni, Pb		vein
398	Merrill and Vance Prospect	033			Ramey Ridge	Au		vein
423	Mother Lode Prospect	033			Ramey Ridge	Au, Ag, Cu	chalcopyrite, malachite	vein
433	Nat Lode Prospect	033			Big Creek	Cu, Ag, Au	chalcopyrite, tetrahedrite	fissure vein
440	No Name Claim Occurrence	033			Big Creek		gold, sulfides	iron-stained hornblendite

* Deposit codes dc1, dc2, dc3 are for 1st-, 2nd-, and 3rd-rank deposit-type components.

map		Deposit Codes*						
no.	Mineral Locality	dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
451	Old Johnson Lode Prospect	033			Middle Fork	Au, Ag, Cu	malachite	vein
468	Pharmacist Prospect	033			Ramey Ridge	Au	gold	vein
475	Portland Occurrence	033			Ramey Ridge	Au	gold	vein
489	Rattlesnake Ridge Prospect	033			Middle Fork (east of PNF)	Au, Ag, Cu	malachite	vein
519	S And B Group Prospect	033			Big Creek	Ag, Cu	malachite, chalcopyrite	vein
525	Schley No. 3 Group Occurrence	033			Ramey Ridge	Au, Cu	chalcopyrite, malachite	vein
534	Silver Dome Claim Prospect	033			Ramey Ridge	Au, Cu, Ag	chalcopyrite, malachite	vein
549	Snowshoe Mine	033			Ramey Ridge	Au, Ag, Cu	chalcopyrite, galena, free gold	vein
550	Snowslide Mountain Occurrence	033			Big Creek	Fe	hematite, magnetite	vein
563	Stonebreaker Prospect	033			Chamberlain Basin	Cu, Ag, Au	chalcopyrite, chalcocite	vein
566	Submarine Claim Prospect	033			Ramey Ridge	Au	gold	vein
572	Sunlight Claims Prospect	033			Ramey Ridge	Au, Cu, Ag	malachite, chalcopyrite	vein
598	Two Friends Claim Occurrence	033			Big Creek	Cu, Ag, Au	malachite, chalcopyrite	vein
613	Upper Iron Clad Claims Prospect	033			Big Creek	Cu, Au, Ag	chalcopyrite	fissure vein
614	Upper Kimmel Creek Occurrence	033			Big Creek	Au, Ag, Cu	chalcopyrite, bornite, azurite, malachite	vein
617	Valley View Claim Occurrence	033			Ramey Ridge	Au, Cu	chalcopyrite	vein
622	Virginia Group Prospect	033			Ramey Ridge	Cu	chalcopyrite, malachite	vein
651	Yates Prospect	033			Ramey Ridge	Au		vein
652	Yellow Jacket Group Prospect	033			Ramey Ridge	Cu, Au, Ag	chalcopyrite, malachite	vein
67	Boise Creek Prospect	034			Dixie (north of PNF)	feldspar, Au	feldspar	pegmatite
106	Churchill Creek Occurrence	034			Dixie (north of PNF)	Ag	silver	pegmatite
175	Eagle Occurrence	034			Chamberlain Basin	Ag		pegmatite
264	Hamilton - Hillsman Claim Prospect	034			Chamberlain Basin	Ag, Au, Cu	malachite	pegmatite
49	Big Squaw Creek Fluorspar Prospect	035			Salmon River (undefined)	F	fluorite	vein
547	Smothers Fluorspar Prospect	035			Salmon River (undefined)	F	fluorite	vein
176	East Brownlee Creek Prospect	038			Cuddy Mountain	Cu	chalcopyrite	intrusive
198	Gabbro Occurrence	038			Mineral	Cu	chalcopyrite	veins
140	Cuddy Mine	044			Cuddy Mountain	Au	pyrite, spec. hematite, magnetite	vein
170	Duches N. Claim Occurrence	044			Indian Creek (s. of e. PNF)	Au, Ag		vein
193	Four V Occurrence	044			Cuddy Mountain	Cu, Au, Ag	chalcopyrite, malachite	vein/shear zone
245	Golzones Claim Group Prospect	044			Heath (undef., nw of Cuddy Mtn)			unclassified
284	Hillside Prospect	044			Edwardsburg	Au		quartz vein
429	Mule Train Claims Occurrence	044			Indian Creek (s. of e. PNF)	Au, Ag, Cu, Pb, W		vein

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

map no.	Mineral Locality	Deposit Codes* dc1	dc2	dc3	Mining District	Commodity	Ore Minerals	Form of Deposit
527	Shellrock Peak Prospect	044			Middle Fork (east of PNF)	Ag, Au, Cu, Pb		alkalic intrusive
542	Slide Prospect Occurrence	044			Indian Creek (s. of e. PNF)	Cu		vein
634	West Fork Adit Prospect	044			Thunder Mountain	Cu		intrusive
648	Wolf Fang Prospect 2	044			South Fork Salmon (undefined)	Au, Ag	sulfides	mafic intrusive
495	Red Ledge No. 6 Occurrence	046			Warren	U, REE		metamorphosed sediments
553	Soda Creek Uranium Occurrence	046			Connor Creek (west of PNF)	U	uranium minerals unknown	unknown

* Deposit codes dc1, dc2, dc3 are for
1st-, 2nd-, and 3rd-rank deposit-type components.

APPENDIX C

Documentation of Digital Data for PNF Mineral Resource Assessment

by

J. Douglas Causey[1]
Dave G. Frank[*]
Andrew Knowles[2]

1

[*] U.S. Geological Survey, Spokane, WA 99201

[2] Department of Geology, Eastern Washington University; currently at Department of Geology, Western Washington University, Bellingham, WA 98225

Table of Contents

List of Tables

Introduction

This appendix describes spatial data used to produce the plate and figures used in this report. Much of this data describes the known mineral localities and the areas that are favorable or permissive for mineral resources in the Payette National Forest. Spatial data obtained from other sources and used to produce the plate and figures is also described.

Some digital spatial geographic data was obtained from the Payette National Forest. Additional data was acquired from the U.S. Bureau of Mines when it closed in 1996. (Some of the data acquired from the Bureau of Mines may have originated with the Forest Service, but there is no documentation of the source.) The remainder of the digital data was developed by converting a digital database (GSMODS), spreadsheet files, and paper materials to Arc/Info coverages.

This appendix discusses the material that was the source of information used to create the coverages, the information contained in the digital files, methods used to convert the databases into a GIS format, documents the file structures, and explains how to download the digital files from the U.S. Geological Survey public access World Wide Web site on the Internet.

Acknowledgments

We would like to thank Charles O'Brien, Payette National Forest, for supplying Arc coverages for the Forest; Chuck Bishop, formerly U.S. Bureau of Mines, for supplying several coverages; and Woody Campbell, for preliminary aml (arc macro language) modifications and documentation of U.S. Bureau of Mines coverages.

Data Sources, Processing, and Accuracy

Mineral property location and associated information was extracted from MRDS (Mineral Resource Data System). The information was modified by examination of the literature, and site visits to selected properties (including properties that weren't in MRDS). The information was then entered into a GSMODS database (Johnson, 1987). Selected data fields were extracted from the GSMODS database to create the pnfmines coverage.

All data presently in GSMODS will be entered into the MRDS database when the procedure is developed and implemented to digitally dump the information to MRDS. Procedures to accomplish this plus making the database accessible via the World Wide Web are being developed by the Spatial Data Delivery and National Mineral Databases projects.

Accuracy of the point locations is variable. Lowest quality accuracy is approximately 2 km, which is indicated in the lat (latitude) and lon (longitude) items by values to the nearest minute. Values to the nearest second are accurate to about 30 meters, and values reported to nearest hundredth of second to 10 meters (decimal precision is greater than true accuracy).

.

The Forest boundary (pnfbdy) and the Snake River (pnfsnake) coverages were obtained from the Payette National Forest. Accuracy is unknown for these coverages.

The mining district boundaries (pnfmdist), towns (pnfcity), township (pnftandr), rivers (pnfrivs), roads (pnfroad), and wilderness boundaries (pnfwild) were obtained from the U.S. Bureau of Mines, Western Field Operations Center, Spokane, WA. A tic file containing corners of 15 minute quadrangles was turned into a point coverage (pnftic) and edited to contain only points in and near the Forest in order to plot latitude and longitude on the maps. Accuracy of these coverages is unknown. However, the Hells Canyon Wild and Scenic Area boundary (in pnfwild) was added by on-screen digitizing and truncated at the Payette National Forest boundary. It is an approximation of the boundary line on the Payette National Forest map, scale 3/8 inch = 1 mile.

The favorable and permissive tract coverages (pnfcoal, pnfmmvcu, pnfskncu, pnfdiscu, pnfsknfe, pnfgyp, pnfhsau, pnfhshg, pnflosau, pnfmmvs, pnfmnlv, pnfplylv, pnfplyvd, pnfporcu) were created for this project. Most of the coverages were digitized from maps developed by USGS mineral resource experts. While all these polygons have some geologic component, some of the favorable/permissive polygons were produced by extracting certain Formation polygons from a digital geologic coverage being developed at 1:100,000 scale(Pam Derkey, personnel communication). These include all or parts of pnfplylv and pnfgyp(TRh, TRps), and pnfmnlv (MzPzb and JPgn) coverages. The remaining polygons were digitized from 1:100,000 scale mylar overlays. Where tract boundaries were open ended at the Forest boundary, the arcs were closed using the Forest boundary coverage (pnfbdy).

All the acquired coverages were either in or re-projected (PROJECT command) to: UTM, Zone 11, Clarke 1866, NAD27, yshift = -5,000,000 to conform to the projection of the coverages made for this project. Previous processing and accuracy of the acquired digital coverages is unknown. The mineral property locations are in latitude - longitude coordinates and were re-projected also.

The favorable/permissive tract coverages were combined with mineral location and geography coverages to create most of the figures in the report. Preliminary maps were created in ArcView 3.0a. The layout was exported to Encapsulated Postscript (EPS) files and final layout work done in Adobe Illustrator v. 7.0.

GIS Documentation

Geographic information systems reference graphic (spatial) data to a coordinate system and separate map features by layers commonly called coverages or themes. This data is mainly composed of points, lines (arcs), or areas (polygons). Descriptive information about the map features is stored with the coverage as attributes. The attributes reside in tables as part of the database of information.

There are 15 new coverages plus 8 pre-existing coverages included in this project. These include: mineral property locations, favorable tracts for deposit types, township, National Forest and management unit boundaries, wilderness boundaries, major rivers, roads, towns, and mining district boundaries. The new coverages created for this project are the mineral property locations and the favorable tracts. Most of the other coverages had to be re-projected for this project. Most all development and modification work was done using Arc/Info version 7.0.4.

The favorable tract coverages include both polygons and arcs. The arcs were digitized from 1:100,000 scale maps and polygons were built (BUILD command) from the arcs. At least one code item was added to each .PAT table to describe the deposit model(s) that fits the area enclosed by the particular polygon. These codes relate to the Pnfmines.dm table, which is a comprehensive list of all deposit models identified in this Payette National Forest study.

All mineral property locations in the GSMODS database were converted to a GIS point coverage (GENERATE command). Several of the data fields in the database were added to the point location tables as attributes (JOINITEM command).

Point Features

Table C-1. Attribute descriptions for items in the PNFMINES.PAT table (GSMODS point locations)

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
MAP_NO	F	8	10	Map number
DEPOSIT	F	33	33	Name of mineral property
P_OR_L	C	1	1	Possible values are p or l. (p = placer, l = lode)
MPO	C	1	1	Possible values are m, p, or o. (m = mine, p = prospect, o = occurrence)
SIGNIF	C	1	1	Possible value is s (s = significant, blank = non-significant)
PRD	C	4	4	Describes if there was any production: Y = yes, N = no
DISTRICT	C	23	23	Mining district name
COUNTY	C	10	10	Idaho County name
DLON	B	10	10	Decimal longitude
DLAT	B	10	10	Decimal latitude
LAT	C	11	11	Latitude - degrees, minutes, seconds
LONG	C	13	13	Longitude - degrees, minutes, seconds
COMMODITY	C	23	23	Mineral commodity present (may be more than one)
DC1	B	4	4	Code for main deposit type present at property. See lookup table PNFMINES.DC.
DC2	B	4	4	Code for secondary deposit type present at property. See lookup table PNFMINES.DC.
DC3	B	4	4	Code for tertiary deposit type present at property. See lookup table PNFMINES.DC.
ORE_MIN	C	57	57	List of ore minerals occurring at property
REFS	C	24	24	Number referring to reference list in GSMODS. (See GSMODS Reference List in References Cited section)
DESCRIPTO	C	34	34	Description of deposit type
MRDS_NO	C	8	8	MRDS number
GSMODS_NO	C	5	5	Number is GS-MODS database. This is of local use only. GS-MODS is not supported anymore.
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFMINES.REF file.

- In addition to the digital GIS layer, which contains the locations of points and associated attributes from the GSMODS database, look-up tables were created for coded items. These tables are described below. All data was extracted February 10, 1997.

Table C-2. PNFMINES.DC lookup table. (Contains deposit type descriptors for codes in DC1, DC2, and DC3 items of PNFMINES coverage.)

CODE	DEPOSIT_TYPE	SYMBOL[1]
1	Gold-silver Mixed-metal Veins	
2	Distal Disseminated Gold-silver	
3	Antimony Veins	
4	Tungsten Veins – Quartz-scheelite	
5	Tungsten Veins – Quartz-huebnerite	
7	Low-sulfide Gold-quartz Veins	
9	Polymetallic Layers and Veins	
10	Copper-silver Polymetallic Veins	
11	Manganese Layers and Veins	
12	Barite Layers and Veins	
13	Porphyry Copper-molybdenum	
14	Copper Skarn	
15	Iron Skarn	
16	Disseminated Copper-silver	
17	Kuroko Zinc-copper Massive Sulfide	
18	Hot-spring Gold-silver	
19	Hot-spring Mercury	
20	Opal	
21	Quartz – Pegmatite, Vein	
22	Mica – Pegmatite, Skarn	
23	Gypsum and Anhydrite	
24	Gold Placer	
25	Black-sand Placer	
26	Rare-earth Placer	
27	Tungsten Skarn	
29	Rare-earth Lode	
30	Gold Skarn	
31	Disseminated Antimony	
32	Zinc-lead Skarn	
33	Copper-gold Mixed-metal Veins	
34	Copper-silver-gold Pegmatite	
35	Quartz-fluorite Veins	
38	Magmatic Copper	
44	Unclassified	
46	Uranium, unclassified	
47	Gem Placer	
49	Diamond Pipes	

[1] Item added for use in plotting. This item is 3 digits (item type is integer) and presently has no values.

Table C-3. PNFMINES.DM lookup table. (Contains model name descriptors for codes in the permissive and favorable tract polygon coverages associated with the Payette National Forest project.)

CODE	MODEL_NAME	SYMBOL[1]
1F	Gold-silver Mixed-metal Veins - favorable tract	
2F	Distal Disseminated Gold-silver - favorable tract	
3F	Antimony Veins - favorable tract	
4P	Tungsten Veins - permissive tract	
7F	Low-sulfide Gold-quartz Veins - favorable tract	
9P	Polymetallic Layers and Veins - permissive tract	
10P	Copper-silver Polymetallic Veins - permissive tract	
11P	Manganese Layers and Veins - permissive tract	
12P	Barite Layers and Veins - permissive tract	
13P	Porphyry Copper-molybdenum - permissive tract	
14F	Copper Skarn - favorable tract	
14P	Copper Skarn - permissive tract	
15P	Iron Skarn - permissive tract	
16P	Disseminated Copper-silver - permissive tract	
17F	Kuroko Zinc-copper Massive Sulfide - favorable tract	
18F	Hot-spring Gold-silver - favorable tract	
18P	Hot-spring Gold-silver - permissive tract	
19F	Hot-spring Mercury - favorable tract	
23P	Gypsum and Anhydrite - permissive tract	
27F	Tungsten Skarn - favorable tract	
27P	Tungsten Skarn - permissive tract	
30P	Gold-bearing Skarn - permissive tract	
31F	Disseminated Antimony - favorable tract	
32P	Zinc-lead Skarn - permissive tract	
33P	Copper-gold Mixed-metal Veins - permissive tract	
50P	Coal (Lignite) - permissive tract	

Table C-4. Attribute descriptions for items in the PNFCITY.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFCITY#	B	4	5	Standard ESRI item
PNFCITY-ID	B	4	5	Standard ESRI item
CITYNAME	C	15	15	Name of city at this point.

[1] Item added for use in plotting. This item is 3 digits (item type is integer) and presently has no values.

Polygon Features

Table C-5. Attribute descriptions for items in the PNFCOAL.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFCOAL#	B	4	5	Standard ESRI item
PNFCOAL-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 50P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFCOAL.REF file.

Table C-6. Attribute descriptions for items in the PNFMMVCU.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFMMVCU#	B	4	5	Standard ESRI item
PNFMMVCU-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 33P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFMMVCU.REF file.

Table C-7. Attribute descriptions for items in the PNFSKNCU.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFSKNCU#	B	4	5	Standard ESRI item
PNFSKNCU-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Possible values = 14F, 14P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFSKNCU.REF file.

Table C-8. Attribute descriptions for items in the PNFDISCU.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFDISCU#	B	4	5	Standard ESRI item
PNFDISCU-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Possible values 12P, 16P and 17F (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
CODE1	I	3	3	Possible values same as CODE
CODE2	I	3	3	Possible values same as CODE
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFDISCU.REF file.

Table C-9. Attribute descriptions for items in the PNFSKNFE.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFSKNFE#	B	4	5	Standard ESRI item
PNFSKNFE-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 15P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFSKNFE.REF file.

Table C-10. Attribute descriptions for items in the PNFGYP.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFGYP#	B	4	5	Standard ESRI item
PNFGYP-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 23 (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFGYP.REF file.

Table C-11. Attribute descriptions for items in the PNFHSAU.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFHSAU#	B	4	5	Standard ESRI item
PNFHSAU-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 18F, 18P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFHSAU.REF file.

Table C-12. Attribute descriptions for items in the PNFHSHG.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFHSHG#	B	4	5	Standard ESRI item
PNFHSHG-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 19F (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFHSHGES.REF file.

Table C-13. Attribute descriptions for items in the PNFLOSAU.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFLOSAU#	B	4	5	Standard ESRI item
PNFLOSAU-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 7F (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFLOSAU.REF file.

Table C-14. Attribute descriptions for items in the PNFMMVS.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFMMVS#	B	4	5	Standard ESRI item
PNFMMVS-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Possible values include: 1F, 4P, 14P, 27P, 30P, 32P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
CODE1	I	3	3	Possible values same as CODE
CODE2	I	3	3	Possible values same as CODE
CODE3	I	3	3	Possible values same as CODE
CODE4	I	3	3	Possible values same as CODE
CODE5	I	3	3	Possible values same as CODE
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFMMVS.REF file.

Table C-15. Attribute descriptions for items in the PNFMNLV.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFMNLV#	B	4	5	Standard ESRI item
PNFMNLV-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 11P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFMNLV.REF file.

Table C-16. Attribute descriptions for items in the PNFBDY.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFBDY#	B	4	5	Standard ESRI item
PNFBDY-ID	B	4	5	Standard ESRI item
ACRES	N	12.2	12.2	Standard ESRI item
DISTRICT	C	20	20	Name of Forest Service administrative unit
DIST	C	4	4	Administrative unit code

Table C-17. Attribute descriptions for items in the PNFMDIST.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFMDIST#	B	4	5	Standard ESRI item
PNFMDIST-ID	B	4	5	Standard ESRI item

This coverage also contains annotation for the polygons lists the mining district name.

Table C-18. Attribute descriptions for items in the PNFTANDR.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFTANDR#	B	4	5	Standard ESRI item
PNFTANDR-ID	B	4	5	Standard ESRI item
TDIR	C	1	1	Township direction; N = north, S = south.
TOWNSHIP	I	3	3	Township number
RDIR	C	1	1	Range direction; E = east, W = west.
RANGE	I	3	3	Range number
TNP	C	8	8	"Redefined item" that has full township and range as 8 character string.

Table C-19. Attribute descriptions for items in the PNFWILD.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFWILD#	B	4	5	Standard ESRI item
PNFWILD-ID	B	4	5	Standard ESRI item
CODE	I	3	3	No data
W_R	C	1	1	w = wilderness, r = recreation area
COLORN	I	3	3	Unknown

Table C-20. Attribute descriptions for items in the PNFPLYLV.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFPLYLV#	B	4	5	Standard ESRI item
PNFPLYLV-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Possible values = 9P, 23P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
CODE1	I	3	3	Possible values same as CODE
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFPLYLV.REF file.

Table C-21. Attribute descriptions for items in the PNFPLYVD.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFPLYVD #	B	4	5	Standard ESRI item
PNFPLYVD -ID	B	4	5	Standard ESRI item
CODE	I	3	3	Possible values = 2F, 3F, 31F (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
CODE1	I	3	3	Possible values same as CODE
CODE2	I	3	3	Possible values same as CODE
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFPLYVD.REF file.

Table C-22. Attribute descriptions for items in the PNFPORCU.PAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
AREA	F	4	12.3	Standard ESRI item
PERIMETER	F	4	12.3	Standard ESRI item
PNFPORCU#	B	4	5	Standard ESRI item
PNFPORCU-ID	B	4	5	Standard ESRI item
CODE	I	3	3	Only value = 13P (Code used to identify deposit model. See PNFMINES.DM table for deposit model name.)
SOURCE	I	4	4	Numeric code used to identify the data source for the feature. Complete reference for the source is listed in the PNFPORCU.REF file.

Table C-23. Attributes for items in the source reference tables for PNFMINES.REF, PNFCOAL.REF, PNFMMVCU.REF, PNFSKNCU.REF, PNDISCU.REF, PNFSKNFE.REF, PNFGYP.REF, PNFHSAU.REF, PNFHSHG.REF, PNFLOSAU.REF, PNFMNLV.REF, PNFMMVS.REF, PNFPLYLV.REF, PNFPLYVD.REF, PNFPORCU.REF tables.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
SOURCE	I	4	4	Numeric code used to identify the data source for the feature.
SCALE	I	10	10	Scale of source map
AUTHORS	C	100	100	Authors or editors of source map, last name, first name or initial, middle initial
YEAR	I	4	4	Source (map) publication date
REFERENCE	C	250	250	Remainder of reference in USGS format

Line Features

Table C-24. Attribute descriptions for items in the PNFRIVS.AAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
FNODE#	B	4	5	Standard ESRI item
TNODE#	B	4	5	Standard ESRI item
LPOLY#	B	4	5	Standard ESRI item
RPOLY#	B	4	5	Standard ESRI item
LENGTH	F	4	12.3	Standard ESRI item
PNFRIVS#	B	4	5	Standard ESRI item
PNFRIVS-ID	B	4	5	Standard ESRI item

Table C-25. Attribute descriptions for items in the PNFROAD.AAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
FNODE#	B	4	5	Standard ESRI item
TNODE#	B	4	5	Standard ESRI item
LPOLY#	B	4	5	Standard ESRI item
RPOLY#	B	4	5	Standard ESRI item
LENGTH	F	4	12.3	Standard ESRI item
PNFROAD#	B	4	5	Standard ESRI item
PNFROAD-ID	B	4	5	Standard ESRI item

Table C-26. Attribute descriptions for items in the PNFSNAKE.AAT table.

ITEM NAME	ITEM TYPE	ITEM WIDTH	ITEM OUTPUT	ATTRIBUTE DESCRIPTION
FNODE#	B	4	5	Standard ESRI item
TNODE#	B	4	5	Standard ESRI item
LPOLY#	B	4	5	Standard ESRI item
RPOLY#	B	4	5	Standard ESRI item
LENGTH	F	4	12.3	Standard ESRI item
PNFSNAKE#	B	4	5	Standard ESRI item
PNFSNAKE-ID	B	4	5	Standard ESRI item

Obtaining Digital Data

The complete digital files are available in Arc/Info export format with associated data files. These data and map images are maintained in a UTM map projection:

Projection:	UTM
Zone:	11
Units:	Meters
Datum:	NAD27
Spheroid:	Clarke 1866
Yshift:	-5,000,000.00
Xshift:	0.00000

To obtain copies of the digital data, do one of the following:

1. Download the digital files from the USGS public access World Wide Web site on the Internet: **URL = http://wrgis.wr.usgs.gov/docs/northwest_region/ofr98-219a.html**

or

2. Anonymous FTP from **wrgis.wr.usgs.gov**, in the directory **pub/geologic/northwest_region/geology/ofr98-219a**

The Internet sites contains Arc/Info EXPORT-format files (pnfmines.e00, pnfmdist.e00, pnfwild.e00, pnfcoal.e00, pnfmmvcu.e00, pnfskncu.e00, pnfdiscu.e00, pnfsknfe.e00, pnfgyp.e00, pnfhsau.e00, pnfhshg.e00, pnflosau.e00, pnfmmvs.e00, pnfmnlv.e00, pnfplylv.e00, pnfplyvd.e00, pnfporcu.e00, pnfbdy.e00, pnfrivs.e00, pnfroad.e00 and pnfsnake.e00, pnftic.e00), text and aml files that produced Plate 1, and a HPGL2 plot file (pnfplate1.hp) which was used to plot the map at a scale of 1:200,000. These files have been tarred and compressed (pnfmines.e00.Z, pnfdepmd.tar.Z, pnfplate1.hp.Z, pnfmap.tar.Z, and pnftext.tar.Z).

To manipulate this data in a geographic information system (GIS), you must have a GIS that is capable of reading Arc/Info Export formatted files and a computer capable of reading UNIX ASCII files. To use these files on a DOS computer, they must be put through a UNIX-to-DOS filter. To use the .e00 files in ArcView v. 3x, use Import71.

References Cited

Johnson, B.R., 1987, GSMODS - A personal mineral occurrence database system reference manual, version 1.01: U.S. Geological Survey Open-File Report 87-636, 225 p.

<u>GSMODS Reference List</u>

1 , , Commodity Files, U.S. Geological Survey, Spokane WA.

2 Livingston, D. C., and Laney, F. B., 1920, The copper deposits of the Seven Devils and adjacent districts: Idaho Bureau of Mines and Geology Bulletin 1, 105 p.

3 Brooks, H. C., and Ramp, L., 1968, Gold and silver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 61, p. 93-100.

4 Oregon Dept. Of Geol. and Min. Industries, 1939, Oregon metal mines handbook; northeastern Oregon, east half: Bulletin 14-A, p. 60.

5 Fredericksen, R., Gallagher, T. P., and Juhas, A. P., 1976, Precious and base metal mineralization at the Iron Dike and Red Ledge deposits (abs.): Northwest Mining Association Annual Convention Abstracts, Spokane, Washington.

6 Brooks, H. C., and others, 1981, Map of the geology and gold deposits of the Bourne Quadrangle, Baker and Grant Counties, Oregon; Oregon Department of Geology and Mineral Industries Map GMS-19.

7 Vallier, T. L., 1974, A preliminary report on the geology of part of the Snake River Canyon, Oregon and Idaho: Oregon Department of Geology and Mineral Industries Map GMS-6.

8 Gammell, R. M., 1942, Olympic and Allen Mines, Wallowa County, Oregon: U.S. Bureau of Mines War Minerals Memorandum, Project 216.

9 Hull, D. A., 1976, Summary report, Red Mound prospect: Oregon Department of Geology and Mineral Industries Unpublished Report.

10 Brooks, H. C., and Vallier, T. L., 1970, Geology and copper deposits of the Homestead area, Oregon and Idaho: Oregon Department of Geology and Mineral Industries, The Ore Bin, 32, no. 3, p. 53.

11 Cook, E. F., 1954, Mining geology of the Seven Devils region: Idaho Bureau of Mines and Geology Pamphlet 97, 22 p.

12 Carter, W. D., and Savage, C. N., 1964, Mineral resources - silica, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 180.

13 Vallier, T. L., and Brooks, H. C., 1970, Geology and copper deposits of the Homestead area, Oregon and Idaho: The Ore Bin, v. 32, no. 3, p. 54.

14 Armstrong, F. C., 1964, Mineral resources - uranium, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 233-239.

15 Storch and Holt, 1963, U. S. Bu. Mi. R. I. 6319.

16 Lemmon, D. M., and Tweto, O. L., 1962, Tungsten in the U.S.: U.S. Geological Survey Map, MR-25.

17 Morganti, J. M., 1972, Geology and ore deposits of the Cuprum area, Seven Devils Mining District, Hells Canyon, Idaho: Pullman, Washington, Washington State University, M.S. thesis, 153 p.

18 Long, R. C., 1976, Geology and mineral deposits of the Red Ledge Mine area, Adams County, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 115 p.

19 U.S. Bur. Mines, 1975, Activity of Idaho mining properties, 1974: U.S. Bureau of Mines, Boise, Idaho, 61 p.

20 Spokane Chronicle, June 1, 1971; FEB. 2, 1971; Dec. 8, 1970.

21 Lorain, S. H., and Metzger, D. H., 1938, Reconnaissance of placer mining districts in Idaho County, Idaho: U.S. Bureau of Mines Information Circular 7023, 93 p.

22 Stoll, W. C., 1950, Mica and beryl pegmatites in Idaho and Montana: U.S. Geological Survey Professional Paper 229, 64 p.

23 Spokane Chronicle, Jan. 31, 1973 ; NOV. 9, 1973

25 Cannon and Grimald, 1958, Lindgrenite & cuprotungstite from Seven Devils District, Idaho: American Minerals v. 38.

26 Fryklund, V. C., Jr., 1951, A reconnaissance of some Idaho feldspar deposits: Idaho Bureau of Mines and Geology Pamphlet 91, p. 19-20.

27 Ross, C. P., and Carr, M. S., 1941, The metal and coal mining districts of Idaho, with notes on nonmetallic mineral resources of the state: Idaho Bureau of Mines and Geology Pamphlet 57, part 1.

28 Brooks, H. C., 1978, Geologic map of the Oregon part of the Mineral Quadrangle: Oregon Department of Geology and Mineral Industries Map, GMS-12.

29 Matthews, T. C., 1955, Oregon radioactive discoveries in 1954 and 1955: Oregon Department of Geology and Mineral Industries, The Ore Bin, v. 17, no. 12, p. 88.

30 Henricksen, T., 1974, Geology and mineral deposits of the Mineral-Iron Mountain District, Idaho: Corvallis, Oregon State University, Ph.D. Dissertation, p. 118-120.

31 Staley, W. W., 1945, Fine gold of the Snake River and lower Salmon River, Idaho: Idaho Bureau of Mines and Geology Pamphlet 72, 11 p.

32 Livingston, D. C., 1919, Tungsten, cinnabar, manganese, molybdenum, and tin deposits of Idaho: University of Idaho Bulletin, v. 14, no. 2, 72 p.

33 Withington, C. F., 1964, Mineral resources - gypsum, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 101-104.

34 Prinz, W. C., 1964, Manganese, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 116-119.

35 Mackin, J. H., 1953, Iron ore deposits of the Iron Mountain District, Idaho: U.S. Geological Survey Bulletin 982-E, 30 p.

36 Shannon, E. V., 1926, Minerals of Idaho: U.S. National Museum Bulletin 131, p. 344.

37 Turner, H. W., 1908, The ore deposits at Mineral, Idaho: Economic Geology, v. 3, no. 6, p. 492-502.

38 Anderson, A. L., 1963, Silver mineralization in the Mineral District, Idaho: Economic Geology, v. 58, no. 8, p. 1195-1217.

39 Smolak, G. M., 1924, An investigation of the metallurgical treatment of a low grade silver ore from the Mineral Mine at Mineral, Idaho: Moscow, Idaho, University of Idaho, M.S. Thesis, 51 p.

40 Fryklund, V. C., Jr., 1951, Note on the occurrence of corundum in Idaho: American Mineralogist, v. 36, no. 9-10, p. 776-778.

41 Bell, R. N., 1907, Sapphires in Idaho: The Mining World, v. 26, p. 449.

42 Bell, R. N., 1907, Eighth annual report of the mining industry of Idaho for the year 1906, 172 p.

43 Bell, R. N., 1913, Fourteenth annual report of the mining industry of Idaho for the year 1912, 190 p.

44 Thayer, T. P., and Brown, C. E., 1964, Pre-tertiary orogenic and plutonic intrusive activity in central and northeast Oregon: Geology Society of America Bulletin, v. 75, no. 12, p. 1255-1262.

45 King, J. R., 1970, The geology of the southeastern Cuddy Mountain District, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, p. 71.

46 Bailey, E. H., , U.S. Geological Survey, Personal Files.

47 Fankhauser, R. E., 1969, Geology and mineralization of the Southern Cuddy Mountains, Washington County, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 138 p.

48 Bruce, W. R., 1971, Geology, mineral deposits, and alteration of parts of the Cuddy Mountain District, western Idaho: Corvallis, Oregon, Oregon State University, Ph.D. thesis, 165 p.

49 Slater, M. N., 1969, Geology and mineral deposits of the western Cuddy Mountain District, western Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 82 p.

50 Storch, R. H., 1958, Ilmenite and other black-sand minerals in the Gold Fork placer deposit, Valley County, Idaho: United States Bureau of Mines Report Investigations 5395, 15 p.

51 Staley, W. W., 1962, Four V: Idaho Bureau of Mines and Geology Open-File Report.

52 Ross, C. P., 1956, Quicksilver deposits near Weiser, Washington County, Idaho: U.S. Geological Survey Bulletin 1042-D, p. 79-104.

53 Skurla, S. J., 1974, Geology of the Sturgill Peak area, Washington County, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 98 p.

54 Staley, W. W., 1955, Burntrock prospect: Idaho Bureau of Mines and Geology Open-File Report, 2 p.

55 Western Mining News, Mar. 18, 1977, p. 10-11.

56 Livingston, D. C., 1923, A geologic reconnaissance of the Mineral and Cuddy Mountain Mining Districts, Washington and Adams Counties, Idaho: Idaho Bureau of Mines and Geology Pamphlet 13, 24 p.

57 Western Mining News, Mar. 14, 1975.,

58 Bell, R. N., 1919, The Ixl copper prospect: Engineering and Mining Journal, v. 108, no. 10, p. 400-402.

59 Idaho Department Of Labor and Industrial Services, First Annual Report Addendum, July 1, 1974 - JUNE 30, 1975, 95 P.

60 Wracher, David, 1969, The geology and mineralization of the Peck Mountain area, Hornet Quadrangle, Idaho: Corvallis, Oregon, Oregon State University, M.S. thesis, 78 p.

61 Anderson, A. L., and Wagner, W. R., 1952, Reconnaissance geology and ore deposits of the Mineral District, Washington County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 95, 26 p.

62 Lesure, F. G., 1964, Mica and associated pegmatite minerals, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report 1, p. 123-133.

63 Savage, C. N., 1961, Economic geology of central Idaho blacksand placers: Idaho Bureau of Mines and Geology Bulletin 17, p. 12.

64 Asher, R. R., 1964, Mineral resources - iron, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 104-111.

65 Weis, P. L., Schmitt, L. J., and Tuchek, E. T., 1972, Mineral resources of the Salmon River Breaks Primitive Area, Idaho: U.S. Geological Survey Bulletin 1353-C, p. 55.

66 Reed, J. C., 1937, Geology and ore deposits of the Warren Mining District, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 45, 65 p.

67 Pattee, E. C., and others, 1968, Beryllium resources of Idaho, Washington, Montana, and Oregon: U.S. Bureau of Mines Report Investigations 7148, 169 p.

68 Mercury In Idaho, 1965, U.S. Bureau of Mines IC 8252.

69 Shenon, P. J., and Ross, C. P., 1936, Geology and ore deposits near Edwardsburg and Thunder Mountain, Idaho: Idaho Bureau of Mines and Geology Pamphlet 44, 45 p.

70 Lindsey, E., 1958, Geology and ore deposits of the northern half of the Big Creek Quadrangle, Idaho: Berkeley, California, University of California, M S. thesis, 67 p.

71 Spence, R. L., 1936, Geology and ore deposits of the Red Metals Mine, Yellow Pine District, Idaho: Moscow, Idaho, University of Idaho, B.S. thesis, 19 p.

72 Bell, R. N., 1912, Thirteenth annual report of the mining industry of Idaho for the year 1911.

73 Mining and Scientific Press, 1914, Big Creek Mining District: Mining and Scientific Press, v. 109, p. 110-111.

74 Bell, R. N., 1920, Twenty-first annual report of the mining industry of Idaho for the year 1919.

75 Jacobs, M. H., 1903, Report of the mining districts of Idaho for the year 1902.

76 Bell, R. N., 1904, Report of the mining districts of Idaho for the year 1903.

77 Mackin, J. H., 1947, Iron ore deposits in the Clearwater District, Idaho County, Idaho: U.S. Geological Survey Open-File Report, 20 p.

78 Lorain, S. H., 1938, Gold mining and milling in Idaho County, Idaho: U.S. Bureau of Mines Information Circular 7039, 90 p.

79 Cater, F. W., and others, 1973, Mineral resources in the Idaho Primitive Area and vicinity, Idaho: U.S. Geological Survey Bulletin 1304, 431 p.

80 Capps, S. R., and Roberts, R. J., 1939, The Dixie Placer District, Idaho: Idaho Bureau of Mines and Geology Pamphlet 48, 35 p.

81 Roberts, R. J., 1938, The petrography and ore deposits of the Dixie District, Idaho: Seattle, Washington, University of Washington, M.S. thesis, 61 p.

82 O'Connor, D. M., 1936, Treatment of ore from the Dixie Comstock Gold Mine, Dixie, Idaho: Seattle, Washington, University of Washington, B.S. thesis, 49 p.

83 Bell, R. N., 1905, Report of the mining districts of Idaho for the year 1904.

84 Bell, R. N., 1908, Ninth annual report of the mining industry of Idaho for the year 1907.

85 Bell, R. N., 1918, Nineteen annual report of the mining industry of Idaho for the year 1917.

86 Shenon, P. J., and Reed, J. C., 1934, Geology and ore deposits in the Elk City, Orogrande, Buffalo Hump, and Tenmile Districts, Idaho County, Idaho: U.S. Geological Survey Circular 9, 89 p.

87 Jones, R. W., 1959, Durden Mine: Idaho Bureau of Mines and Geology Open-File Report.

88 Capps, S. R., 1940, Gold placers of the Secesh Basin, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 52, 43 p.

89 Griner, W. C., 1975, Seventy-first annual report of the mining industry of Idaho for 1973-1974, 98 p.

90 Sorenson, R., 1937, Minerals from certain placer deposits in Idaho: Moscow, Idaho, University of Idaho, B.S. thesis, 22 p.

91 Czizek, J. A., 1900, Report of the Inspector of Mines for the State of Idaho for the year 1899.

92 Lindgren, W., 1900, The gold and silver veins of Silver City, De Lamar, and other mining districts in Idaho: U.S. Geological Survey 20th Annual Report, part III, p. 67-256.

93 Powers, H. A., 1955, Red Ledge No. 6: Idaho Bureau of Mines and Geology Open-File Report.

94 Reed, J. C., 1939, Geology and ore deposits of the Florence Mining District, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamphlet 46, 44 p.

95 Spokane Chronicle, Nov. 3, 1972; APRIL 24, 1972; Nov. 15, 1971.

96 Hobbs, S. W., 1964, Mineral resources - tungsten, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report no. 1, p. 223-233.

97 Pointon, S. J., 1921, Warren Mining District: Northwest Mining Truth, v. 6, no. 13, p. 3-4.

98 Hill, W. H., 1896, The Little Giant Mine at Warren, Idaho: Engineering Mining Journal, v. 62, p. 416.

99 Kirkpatrick, G. E., 1974, Geology and ore deposits of the Big Creek area, Valley and Idaho Counties, Idaho: Moscow, Idaho, University of Idaho, M.S. thesis, 92 p.

100 Koschmann, A. H., and Bergendahl, M. H., 1968, Principal gold-producing districts of the United States: U.S. Geological Survey Professional Paper 610, p. 133.

101 Leonard, B. F., 1965, Mercury-bearing antimony deposit between Big Creek and Yellow Pine, central Idaho: U.S. Geological Survey Professional Paper 525-B, p. 27.

102 Cook, E. F., 1956, Tungsten deposits of south-central Idaho: Idaho Bureau of Mines and Geology Pamphlet 108, 40 p.

103 Leonard, B. F., and others, 1968, Silver-rich disseminated sulfides from a tungsten-bearing quartz lode, Big Creek District, central Idaho: U.S. Geological Survey Professional Paper 594-C.

104 Western Mining News, July 5, 1974. ALSO WESTERN MIN. NEWS, 1974-75 Directory of Mines In Idaho (Coeur D'Alenes) and Washington, p. 29.

105 Western Mining News, May 2, 1975.,

106 Western Mining News, Nov. 21, 1975.,

107 Cole, J. W., and Bailey, H. D., 1948, Exploration, development, mining, and milling of a unique tungsten ore body at Yellow Pine Mine, Stibnite, Idaho: U.S. Bureau of Mines Information Circular 7443, 24 p.

108 Schrader, F. C., and Ross, C. N., 1926, Antimony and quicksilver deposits in the Yellow Pine District, Idaho: U.S. Geological Survey Bulletin 780, p. 137-167.

109 Currier, L. W., 1935, A preliminary report of the geology and ore deposits of the eastern part of the Yellow Pine District, Idaho: Idaho Bureau of Mines and Geology Pamphlet 43, 27 p.

110 Ross, C. P., 1927, Ore deposits in the tertiary lava in the Salmon River Mountains, Idaho: Idaho Bureau of Mines and Geology Pamphlet 25, 20 p.

111 Bailey, E. H., 1964, Mineral resources - mercury, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology, Special Report no. 1, p. 119-123.

112 Metal Market Consultants Inc., 1987, Gold Situation Map.

113 Laheist, B. A., 1964, Mineral resources - antimony, in, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology, Special Report no. 1, p. 41-46.

114 Bell, R. N., 1919, Twentieth annual report of the mining industry of Idaho for the year 1918.

115 Adams, J. W., 1968, Rhabdophane from a rare-earth occurrence, Valley County, Idaho: U.S. Geological Survey Professional Paper 600-B, p. B48-B51.

116 Cooper, J. R., 1951, Geology of tungsten, antimony, and gold deposits near Stibnite, Idaho: U.S. Geological Survey Bulletin 969-F, p. 151-195.

117 Minobras, 1975, Idaho industrial minerals: Minobras, p. 34-36.

118 Bell, R. N., 1935, The gold resources of Idaho: Mining and Contracting Review, v. 33, no. 37.

119 Mining Record, , Dec. 6, 1972.

120 Bell, R. N., 1914, Fifteenth annual report of the mining industry of Idaho for the year 1913, 225 p.

121 Campbell, A., 1947, Forty-eighth annual report of the mining industry of Idaho for the year 1946.

122 Campbell, A., 1946, Forty-seventh annual report of the mining industry of Idaho for the year 1945.

124 Idaho Bureau of Mines and Geology, 1970, Open-File Report On Antimony.

128 Adams, J. W., 1968, Rhabdophane from a rare-earth element occurrence, Valley County, Idaho: U.S. Geological Survey Professional Paper 600B, p. B48-B51.

130 Varley et al, 1919, p.43,51,45-47

132 Adams, J.W, 1968, Rhabdophane from a rare-earth element occurrence, Valley County, Idaho: US Geological Survey Professional Paper 600B, p. B48-51.

134 Peterson, M. A., 1984, Geology of the Quartz Creek tungsten deposit, Yellow Pine, Idaho: M.S. thesis, Kent State University, 94p.

135 Shrader and Ross, 1926, Antimony and quicksilver deposits of the Yellow Pine district, Idaho: USGS Bulletin 780, p. 137-165.

136 Leonard, B.F., 1973, Gold anomaly in soil of the West End Creek area, Yellow Pine district, Valley County, Idaho, U.S. Geological Survey Circular 680, 16 p.

137 Cooper, J.R., 1951, Geology of the tungsten, antimony, and gold deposits near Stibnite, Idaho: USGS Bulletin 969 F, p. 151-197.

138 Cooper, J. R., 1951, Geology of the tungsten, antimony, and gold deposits near Stibnite, Idaho.

139 Alexander, David and Wursten, Jane, 1994, Stibnite Mine expansion project: Draft environmental impact statement; USDA Forest, Krassal Ranger District, Payette National Forest, Valley County, Idaho.

140 Cookro, T.M., Silberman, M.L., and Berger, B.R., 1988, Gold-Tungsten bearing hydrothermal deposits in the Yellow Pine mining district, Idaho: in Schafer, R.W., Cooper, J.J., and Vikre, P.G., eds., Bulk mineable precious metal deposits of the Western United States: Geological Society of Nevada, Reno, Nevada, p.577-624.

142 White, D.E., 1945, Geologic map of the Yellow Pine District, Valley County, Idaho: U.S. Geological Survey preliminary Strategic map; Strategic Minerals Investigation, scale 1:48,000, text (6pr).