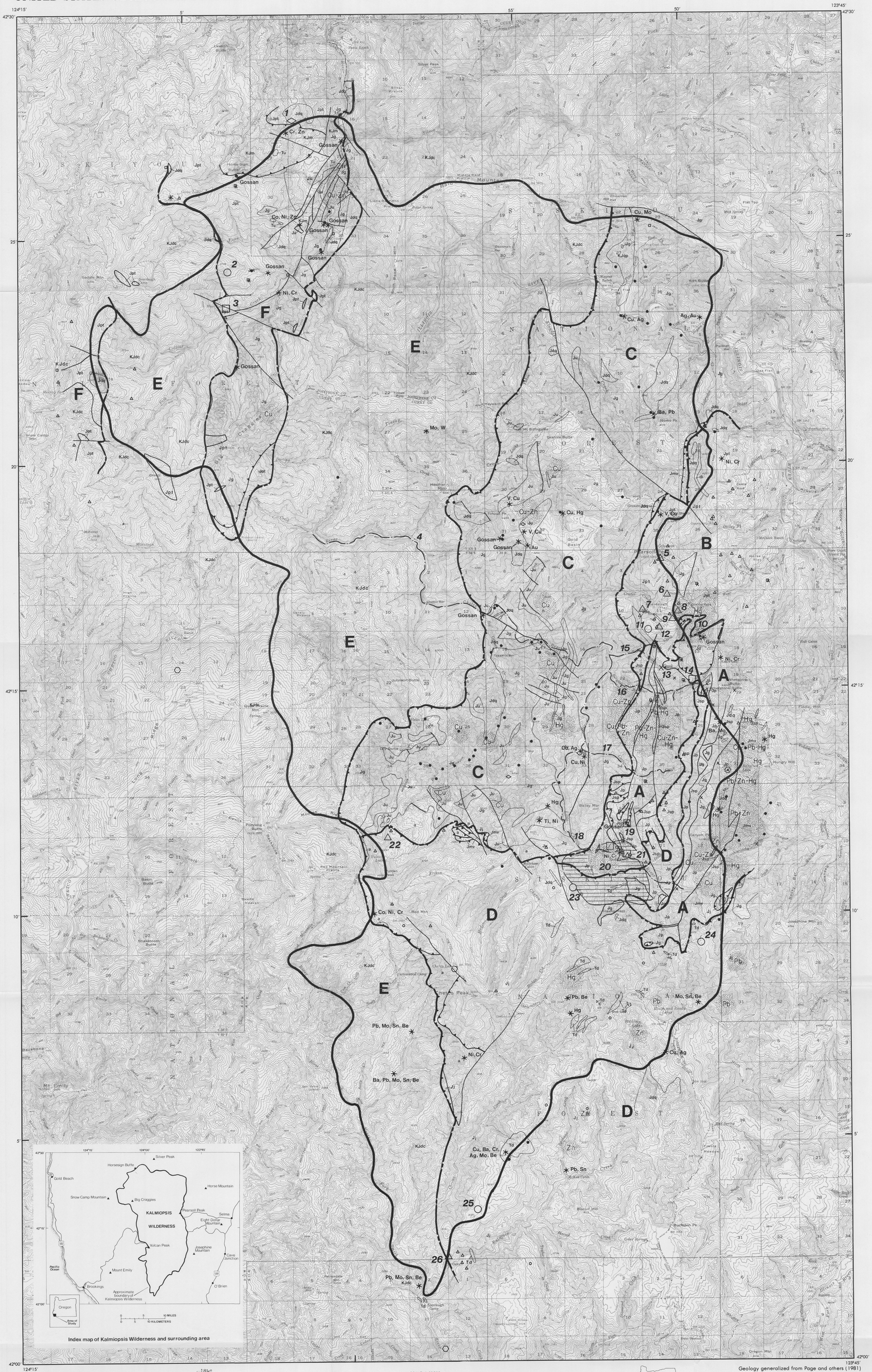
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1240-E



Index map of Kalmiopsis Wilderness and surrounding area

Base from U.S. Geological Survey
Chetco Peak, Collier Butte, Mount Emily
Pearsoll Peak, 1954

SCALE 1:62 500

NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPROXIMATE MEAN DECLINATION 1982

Geology generalized from Page and others (1981)

OREGON
AREA OF MAP

MINERAL RESOURCE POTENTIAL MAP OF THE KALMIOPSIS WILDERNESS, SOUTHWESTERN OREGON

By
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1982

Contact
Fault
Thrust fault
Boundary of Kalmiopsis Wilderness

EXPLANATION

Boundary of subarea based on geologic and geochemical association--Association; areas lettered A through F

Placer deposits with resource estimates--Number in table 1 (map)

Laterite deposit containing Ni, Co, AND Cr with resource estimates--Number refers to locality number in table 1 (map)

Occurrence of lateritic soils

Podiform and disseminated chromite deposit with resouce estimates--Number refers to locality number in table 1 (map)

Podiform and disseminated chromite occurrence, prospect, or previously mined deposit

Massive sulfide deposit containing Cu, Zn, Au, and Ag with resource estimates--Number refers to locality number in table 1

Copper occurrence, prospect, or previously mined deposit

Gold lode mine with mineral resource estimates--Number refers to locality number in table 1 (map)

Gold lode occurrence, prospect, or previously mined deposit either as gold-quartz veins or massive sulfide type deposit

Manganese occurrence, prospect, OR previously mined deposit

Iron prospect in fossilized beach sands--Number refers to locality number in table 1 (map)

Iron occurrence or prospect

Occurrence of pyrite (FeS_2) and other sulfide minerals observed during geologic mapping

Area of geochemically anomalous amounts of metal(s)--Element present shown by chemical symbol

Geochemically anomalous amounts of metals in rock samples--Elements present shown by chemical symbols

Aeromagnetic low possibly representing altered rocks

EXPLANATION

Tu — Dagoua Formation: Sandstone and shale — TERTIARY

Td — Dacite dikes

KJm — Myrtle Group (Lower Cretaceous and Upper Jurassic): Conglomerate, sandstone, and mudstone — CRETACEOUS AND JURASSIC

KJqp — Quartz porphyry

KJdc — Dothan Formation (Cretaceous and Jurassic) and Galebrooke Schist (Upper Jurassic): Sandstone, shale, volcanic rocks, and schist

Jmv — Metavolcanic rocks

Jp — Pyroxene-bearing metavolcanic rocks

Jdq, Jd, Jq, Jm — Intrusive igneous rocks: Jq, diorite and quartz diorite; Jd, dike complex; Jq, gabbroic rocks; Jm, ultramafic rocks, predominantly metacumulate peridotite — JURASSIC

Jpt, Jl, Jmp, Jdi — Ultramafic rocks and dikes: Jpt, peridotite; Jl, Josephine Peridotite (Jurassic or older); Jmp, serpentinite; Jdi, diabase dikes — JURASSIC AND JURASSIC OR OLDER

s — Amphibolite — AGE UNKNOWN

Table 1.--Properties with mineral potential in the Kalmiopsis Wilderness

Locality number	Name	Location	Resource	Type	Development category	Description	Resource estimate
1	Horse Sign Butte Iron	Sec. 17, T. 36 S., R. 11 W.	Vanadium, iron, titanium	Black sand	Prospect	Fossil black beach sand on ridgecrest	An estimated 650,000 long tons (660,000 t) containing 42 percent iron, 0.24 percent vanadium, 0.87 percent chromium, 2.1 percent titanium, and 0.13 percent sulfur.
2	Collier Creek Laterites	Approximate T. 36, 37 S., R. 11, 12 W.	Nickel, chromium, cobalt	Laterite	Prospect	Patchy laterite on serpentinized ultramafics; best developed on landslides and flat areas	About 150,000 short tons (140,000 t) containing about 0.4 percent nickel, 1.2 percent chromium, 0.6 percent cobalt, an estimated 0.001 ounces gold per ton (0.3 g/t) and an estimated 0.1 ounces silver per ton (3 g/t).
3	Hurt Cabin	Approximate T. 37 S., R. 12 W.	Cobalt, copper	Lode	Prospect	Lenses of massive magnetite and sulfides in sheared serpentinite	About 11,000 short tons (10,000 t) containing 3.25 percent copper and 0.13 percent cobalt.
4	Chetco River	Approximate T. 37-1/2, 38, 39 S., R. 10, 11 W.	Gold	Placer	Prospect	ncent and bench gravel along Chetco River, mainly downstream from the Little Chetco River	An estimated 13,000,000 cubic yards (9,900,000 m^3) containing .0007 ounces gold per cubic yard (.028 g/m^3).
5	Pearsoll Peak	Sec. 2, T. 38 S., R. 10 W.	Chromium	Lode	Mine	Massive and disseminated chromite in ultramafic rocks	An estimated 100,000 short tons (90,000 t) containing about 4 percent chromium.
6	Eagles Nest	NE1/4 sec. 11, T. 38 S., R. 10 W.	Chromium	Lode	Mine	Massive chromite in ultramafics	An estimated 30 tons (27 t) containing 5.6 percent chromium.
7	Prospectors Dream	W1/2 sec. 11, T. 38 S., R. 10 W.	Chromium	Lode	Prospect	Massive chromite lenses and aggregates of chromite in ultramafic rock	About 50 short tons (45 t) of chromite containing 24.9 percent chromium, 0.06 ounces gold per ton (2.1 g/t) and 1.15 ounces silver per ton (39.4 g/t).
8	Little Sourdough No. 2	E1/2 sec. 11, T. 38 S., R. 10 W.	Chromium	Lode	Mine	Mainly disseminated chromite in serpentinite	About 50,000 short tons (45,000 t) containing about 1.5 percent Cr_2O_3.
9	Found Again	SE1/4 sec. 11, T. 38 S., R. 10 W.	Chromium, gold, silver	Lode	Mine	Chromite blebs and stringers in ultramafics	At least 140 short tons (130 t) containing about 1.1 percent chromium, 0.03 ounces gold per ton (1 g/t), and 0.2 ounces silver per ton 7 g/t)
10	Stone	SW1/4 sec. 12, T. 38 S., R. 10 W.	Copper, gold, silver	Lode	Prospect	Scattered, faulted, small lenses of massive sulfides and magnetite(?) in metavolcanic and ultramafic rocks	About 90,000 short tons (80,000 t) containing 1.8 percent copper, 0.04 ounce gold per ton (1.4 g/t) and 0.2 ounce silver per ton (7 g/t).
11	B & C Laterite	SW1/4 sec. 11, NW1/4 sec. 14, T. 38 S., R. 10 W.	Nickel, chromium, cobalt	Laterite	Prospect	Laterite on landslide(?) bench; mostly overlies ultramafic rock	At least 120,000 short tons (110,000 t) containing 0.64 percent nickel, 1.14 percent chromium, 0.054 percent cobalt, 0.016 percent copper, and estimated 0.009 ounces gold per ton (0.3 g/t).
12	Wonder 1-3	S1/2 sec. 11, N1/2 sec. 14, T. 38 S., R. 10 W.	Chromium, gold, silver	Lode	Mine	Chromite masses in ultramafic rock; some disseminated chromite	At least 55 short tons (50 t) containing 11.9 percent chromium; average of 0.03 ounces gold per ton (1.0 g/t) in chromite and 0.6 ounces silver per ton (20.6 g/t) in chromite.
13	Rouvett E.	N1/2 sec. 23, T. 38 S., R. 10 W.	Gold	Lode	Mine	Quartz veins near contact of metavolcanics and ultramafics	An estimated 70,000 short tons (60,000 t) may contain an estimated 0.004 ounces gold per ton (0.1 g/t). About 170 short tons (150 t) may contain 0.05 ounces gold per ton (1.1 g/t).
14	Eagle Creek	NW1/4 sec. 24, T. 38 S., R. 10 W.	Copper, gold, silver	Lode	Prospect	Scattered, faulted, small lenses of massive sulfides and magnetite in ultramafics and metavolcanics	An estimated 100,000 short tons (90,000 t) containing about 2.9 percent copper, 0.025 ounces gold per ton (0.8 g/t), 0.43 ounces silver per ton (15 g/t), 0.05 percent cobalt, and 0.07 percent zinc.
15	Slide Creek	Secs. 14, 15, T. 38 S., R. 10 W.	Gold	Placer	Mine	Recent and bench gravel. Partly mined out	Extensive mining indicates some resource potential; lode gold prospects and mines nearby are a source of placer gold.
16	Babyfoot Creek	Secs. 22, 23, 24, T. 38 S., R. 10 W.	Gold	Placer	Prospect	Recent and bench gravel	About 200,000 cubic yards (150,000 m^3) may contain about 0.02 ounces of gold per cubic yard (0.8 g/m^3).
17	Carter Creek	Secs. 33, 34, 35, 36, T. 38 S., R. 10 W.	Gold	Placer	Prospect	Recent and bench gravel	About 400,000 cubic yards (300,000 m^3) may contain about 0.001 ounces of gold per cubic yard (0.04 g/m^3).
18	Little Chetco River	Approximate Secs. 4, 5, 9, 10, 14, T. 39 S., R 10 W.	Gold	Placer	Prospect	Recent and bench gravel. Partly mined out	About 1,300,000 cubic yard (1,100,000 m^3) may contain about 0.005 ounces of gold per cubic yard (0.2 g/m^3).
19	Upper Copper Creek	SE1/4 sec. 3, T. 39 S., R. 10 W.	Copper, gold, silver	Lode	Prospect	Sulfides in intensely weathered, altered ultramafics and possibly metavolcanics	An estimated 50,000 short tons (45,000 t) may contain 0.3 percent copper and 0.7 ounces silver per ton (24 g/t).
20	West Copper Creek	W1/2 sec. 10, T. 39 S., R. 10 W.	Silver, zinc, copper, gold	Lode	Prospect	Sulfides near contact of metavolcanics with serpentinite	An estimated 3,000,000 short tons (2,700,000 t) may contain an estimated 0.001 ounces gold per ton (0.03 g/t), about 0.5 ounces silver per ton (17 g/t), 0.08 percent copper, and 0.2 percent zinc.
21	Emily	SE1/4 sec. 10, T. 39 S., R. 10 W.	Copper, gold, silver, chromium	Lode	Mine	Lenses of massive magnetite and sulfides in metavolcanics and ultramafics. Some chromite (massive and disseminated) in ultramafics	About 260 short tons (230 t) may contain about 1.11 percent copper, 0.03 ounces gold per ton (1 g/t), 0.12 ounces silver per ton (4 g/t).
22	Gardner Group	Approximate T. 39 S., R. 11 W.	Chromium	Lode	Mine	Chromite lenses in ultramafics	Approximately 800 short tons (700 t) may contain about 5.6 percent chromium.
23	Upper Chetco Laterites	Approximate T. 39 S., R. 10 W.	Nickel, chromium, cobalt	Laterite	Prospect	Patchy laterites on ultramafic and mafic rocks	About 600,000 short tons (500,000 t) may contain 0.52 percent nickel, 1.7 percent chromium, 0.07 percent cobalt, 0.008 percent copper, and 0.02 ounces gold per ton (0.7 g/t).
24	Square Lake Laterite	Approximate S1/2 sec. 24, N1/2 sec. 25, T. 39 S., R. 10 W.	Nickel, chromium, cobalt	Laterite	Prospect	Patchy laterite on ultramafic and mafic rocks	About 200,000 short tons (180,000 t) may contain 0.35 percent nickel, 0.77 percent chromium, 0.04 percent cobalt, and 0.007 percent copper.
25	Baldface Ridge Laterites	Approximate T. 40 S., R. 10, 11 W.	Nickel, chromium, cobalt	Laterite	Prospect	Patchy laterites on ultramafic rocks	About 250,000 short tons (200,000 t) may contain about 0.6 percent nickel, 1.8 percent chromium, 0.16 percent cobalt, and 0.08 ounces silver per ton (2.7 g/t).
26	Baldface 1 and 2 (Sourdough)	Approximate SE1/4 sec. 35, SW1/4 sec. 36, T. 40, S., NE1/4 sec. 2, NW1/4 sec. 1, T. 41 S., R. 11 W.	Chromium	Lode	Mine	Massive and disseminated chromite in ultramafic rocks	40,000 tons (36,000 t) with 5 percent Cr_2O_3. Potential for massive chromite.

MINERAL RESOURCE ASSESSMENT MAP OF THE KALMIOPSIS WILDERNESS AREA

By N. J Page, M. S. Miller, D. J. Grimes, R. W. Leinz, R. J. Blakely, Bruce Lipin, M. P. Foose, and Floyd Gray

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577), September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral resource potential survey of the Kalmiopsis Wilderness in the Siskiyou National Forest, Josephine and Curry Counties, Oregon. Kalmiopsis Wilderness was established by Public Law 88-577, September 1964.

INTRODUCTION

Although not economically significant in 1981, subareas within and immediately adjacent to the Kalmiopsis Wilderness have potential for mineral deposits. The basic observations used in making these judgments are contained in Page and others (1981), Carlson and others (1981) Grimes and Leinz (1981, unpub. data), Blakely and others (1981), Barnard and others (1981), Gray (1980), and M. S. Miller (written commun., 1981). The pertinent geologic, geochemical, geophysical, and engineering information for the potential occurrence of mineral resources is summarized here in map and table form and discussed in the accompanying pamphlet. Previous studies within the area that bear on mineral resources include Ramp (1961, 1975, 1978), Ramp and Peterson (1979), Brooks and Ramp (1968), Hotz (1971), Coleman (1972), and Wells, and others (1949).

MINERAL RESOURCE ASSESSMENT

The geologic environment of structurally broken and tectonically juxtaposed groups of ophiolitic rocks, island-arc volcanic rocks, and poorly sorted sedimentary rocks suggests the possibility that deposits of the following commodities may occur: copper, zinc, lead, gold, silver, mercury, chromium, nickel, cobalt, manganese, iron, platinum-group elements, asbestos, and talc. Each of these possibilities was examined in detail both in the field and laboratory, and the stream-sediment geochemistry (Grimes and Leinz, 1981) indicates no other potential mineral commodities. Commodities with low or nonexistent mineral potential are discussed first in respect to the total wilderness area, and those with more potential are discussed later by subarea.

MINOR COMMODITIES

No extensive areas containing deposits of talc or asbestos were found during the field studies, and none are known from previous exploration. As shown by Barnard and others (1981), both talc and chrysotile (one of the minerals that forms asbestos) are present as products of serpentinization of the ultramafic rocks, but not in the grade and volume needed for commercial deposits.

There are no known economic mercury deposits within the area although Ramp (1975) reports panning cinnabar (HgS) from Miller, Slide, Carter, and Babyfoot Creeks, and in the Little Chetco River. Geochemical studies indicate its presence in areas between Chetco Pass and Eagle Mountain, Carter Creek and Babyfoot Creek and an area centered around Babyfoot Creek.

Occurrences of manganese as oxides associated with cherts and as rhodonite in amphibolite have been described by Ramp (1975) and are shown on the map. The chance of economic concentrations of manganese in the Kalmiopsis Wilderness is considered low, on the basis of geologic and geochemical characteristics of the area.

Iron occurs as magnetite containing minor amounts of vanadium and titanium in two different geologic environments in the Kalmiopsis area. Magnetite, a common rock forming mineral of mafic rocks, occurs in the gabbros locally in concentrations as much as 25 percent of the rock. The prospect (shown on the map) between Tincup Peak and Gold Basin was examined geologically, geochemically, and geophysically by Gray (1980) as part of this study without identifying economic grades and volumes of magnetite rich rock. Iron also occurs as magnetite and in other oxides in a patch of Tertiary sediments interpreted to be a fossil black beach sand. Within the Kalmiopsis area no other occurrence of this type was identified. The economic potential for iron deposits must be considered low.

Rocks from areas A, B, C, D, and E (see map) were analyzed for the platinum-group elements. Most values found are from less than to a few one-one thousandths of a troy ounce per ton (Page and others, 1981a; Page and others, 1975). Individual grab samples in area C near Tincup Peak and along the ridge between the Chetco River and Box Canyon Creek have values of platinum plus palladium up to 0.11 and 0.01 troy ounces per ton, respectively. Continuity of these grab-sample anomalies was not established. The probability of occurrence of a major platinum-group metal deposit in areas A, B, C, D, and E must be considered low.

INDIVIDUAL AREAS

Area E contains no known geologic, geochemical, or geophysical characteristics that would indicate a chance of the occurrence of metallic lode deposits. It has mineral resources of placer gold along the Chetco River. Minor barium, lead, molybdenum, tin, and beryllium anomalies are associated with Tertiary dacite dikes in the southwestern part of area E (Carlson and others, 1981). Evidence against the occurrence of metallic lode deposits includes:

(1). Graywacke, mudstone, siltstone, and shale (without interbedded volcanic rocks) deposited in deep water generally do not contain lode deposits of metals.
(2). There are no significant anomalies in the area.

Area A contains favorable geologic, geochemical, and geophysical characteristics for the occurrence of volcanogenic massive sulfide deposits containing copper, zinc, silver, and gold. These characteristics are:

(1). Presence of irregular, sheared, stratabound lenses of pyritic sulfide minerals, with or without magnetite, containing copper, zinc, silver, and gold (table 1, map sheet; prospects and mines numbered 14, 19, 20, and 21); massive sulfide deposits tend to occur in clusters or groups with intragroup spacings of a few kilometers (Solomon, 1976).
(2). Presence of low-grade, disseminated vein minerals, and hydrothermally altered rock generally stratigraphically below the deposits; however, the stratigraphic position of these features in the area is varied (for example; table 1, map sheet; the mine at loc. 13, and numerous locations of small-sized occurrences of disseminated pyrite, copper, gold, and silver shown on the map).
(3). Presence of mafic to felsic calc-alkaline volcanic rocks (andesite-dacite-rhyodacite) of pyroclastic, subaqueous origin in an island-arc tectonic environment (see Page and others, 1981b, for descriptions of subdivision of pyroxene-bearing metavolcanic rocks and metavolcanic rocks); presence of coarse-grained fragmental rocks which in some deposits (Solomon, 1976) are associated with massive sulfides (see Page and others, 1981b description of pyroxene-bearing agglomerate).
(4). Presence of immature volcanogenic graywacke, siltstone, and shale interbedded with volcanic rocks indicating presence of horizons where volcanism changed to sedimentation (see Page and others, 1981b for subdivision of pyroxene-bearing metavolcanic rocks and metavolcanic rocks).
(5). Presence of minor chert and siliceous tuffs (see Page and others 1981b for subdivision of metavolcanic rocks).
(6). Presence of anomalous amounts of copper, zinc, lead, and manganese in oxide residue of stream sediment samples and mercury in the magnetic fractions of pan concentrates.
(7). Presence of higher than average amounts of base metals in associated volcanic rocks.
(8). Presence of anomalous amounts of barium in rocks or stream sediments.
(9). Presence of an aeromagnetic low in the upper part of the Little Chetco drainage near Emily Cabin (Blakely and others, 1981).

Area A also contains the following negative characteristics:

(1). Rocks are extremely broken up by both northeast- and northwest-trending faults with various offsets.
(2). The abundance of rhyodacitic and rhyolitic rocks appears to be small from field observations.
(3). The range in size and grade of mineable massive sulfide deposits is from about 100,000 to 100,000,000 metric tons and grades between about 1 and 10 percent copper; higher grades are associated with smaller tonnages. The median tonnage and grade of 146 deposits reported by Singer and others (1975) is 2,260,000 metric tons and 2.29 percent copper, which suggest the estimated tonnages and grades in localities 10,14, 19, 20 and 21 (table 1, map sheet) are at this time subeconomic. Further direct exploration might however increase the tonnages and grades available.

Area B contains favorable geologic, geochemical and geophysical characteristics for the occurrence of podiform and disseminated chromite deposits. These characteristics are:

(1). Presence of ultramafic rocks of ophiolitic type that contain extensive areas of dunite tectonites, and cumulates associated with harzburgite tectonite (see Page and others, 1981b, geologic mapping near Pearsoll Peak).
(2). Presence of estimated low-grade resources of podiform and disseminated chromite (table 1, map sheet; locs. 5, 6, 7, 8, and 12).
(3). Occurrence of known or previously mined podiform chromite deposits, prospects, and occurrences associated with dunite.

Area B contains negative characteristics for development of economic podiform chromite deposits.

(1). The range in size of production of 181 previously mined podiform chromite bodies in southwestern Oregon is a few kilograms to 32,430 metric tons; one deposit accounted for half the total productions. The deposits contained an average of 206 metric tons and had a grade between 43 and 51 percent Cr_2O_3 (Page and Johnson, 1977).
(2). Complex faulting and shearing in areas of ultramafic rocks.

Areas B, D, and F contain geologic and geochemical characteristics favorable for the occurrence of lateritic deposits containing nickel, cobalt, and chromium. These features are:

(1). The presence of abundant ultramafic rocks which contain sufficient concentrations of nickel, cobalt, and chromium to be a source for nickel-cobalt-chromium-bearing lateritic soils (see Grimes and Leinz, 1981).
(2). A geomorphic history which allowed for the relatively high rates of chemical weathering and relatively low amounts of physical erosion needed to form lateritic soils (Ramp, 1978).
(3). A tectonic history which made possible the subsequent preservation of laterites either by the uplifting of relatively flat lying blocks or by the concentration of nickel-cobalt-chromium-bearing soils in slump or landslide deposits.
(4). Most important, the widespread occurrence of distinctive red-brown pisolitic soils on ultramafic rocks which are known to be enriched with nickel, cobalt, and chromium. The largest occurrences of these deposits are listed in table 1, map sheet (locs. 2, 11, 23, 24, and 25; others are shown by Ramp, 1978).
(5). A metallurgical process has been developed by the U.S. Bureau of Mines which is specifically designed to process the laterite deposits of this region.

Factors which are unfavorable for the economic development of laterites in areas B, D, and F are the following:

(1). The tonnages of the laterite occurrences seem to be inadequate to justify development. Both Riddle, Oreg., which is currently in production, and the laterite deposits at Gasquet Mountain, Calif., which is quite similar in mode of occurrence to these deposits and is currently undergoing active development work, have more than 20 million tons of ore. An individual deposit or closely grouped set of deposits would probably need to be in excess of 10 million tons to be considered for development, an amount well in excess of the region's estimated resources (table 1, map sheet; table 2, pamphlet).
(2). Nickel grades are probably too low to be considered for development, as a grade of at least 0.65 percent nickel would probably be required. Although the byproduct extraction of chromium and cobalt may help increase the value of the ore, they are not likely to materially affect the basic economics of laterite development.
(3). The relatively large boulder content and the heterogeneity of soils among groups of deposits greatly increases the complexity of handling and processing the laterite and thus reduces its economic attractiveness.
(4). The remoteness of these deposits to existing roads and electricity creates a major additional barrier to their eventual development.
(5). Finally, numerous larger and higher grade laterites exist in nearby areas of Oregon and California as well as in other countries which are much more economically attractive. Interest in these deposits will make future development of laterites in areas B, D, and F less likely.

Area A contains favorable geologic and geochemical characteristics indicating some chance for the occurrence of vein lode gold deposits. These characteristics are:

(1). Presence of estimated resources of lode gold in quartz veins (table 1, map, loc. 13).
(2). Occurrence of previously mined prospects and occurrences of vein gold (see map).
(3). Presence of favorable host rocks including metavolcanic rocks and serpentinite.
(4). Presence of rock broken up by faults along which gold-quartz veins may have been deposited.
(5). Mercury geochemical anomalies associated with the fractured rocks.
(6). Presence of sparsely distributed small quartz veins.
(7). Opportunity during the geologic development of the area for hydrothermal circulation; evidence for this is the known massive sulfide occurrences and pervasive low-grade metamorphism of the volcanic rocks.

Negative characteristics include:

(1). Lack of abundant quartz veins and recognized hydrothermal alteration patterns.
(2). Lack of a known major heat source related to plutonism superimposed on the volcanic and ultramafic rocks; the only known heat sources appear to have existed because of mantle processes and the development of the island-arc volcanic rocks.

Areas C, F, and E contain geologic and geochemical characteristics favorable for the occurrence of placer gold deposits. These characteristics are:

(1). Presence of estimated gold resources in placer deposits in the Chetco and Little Chetco drainages (table 1, map sheet; locs. 4, 15, 16, 17 and 18).
(2). Presence of placer deposits previously mined for gold and estimated 2,500 oz of gold produced from Slide, Miller, Babyfoot, and Carter Creeks and the Little Chetco River (Ramp, 1975).
(3). Presence of alluvium and terraces in the Chetco and Little Chetco drainages; most are too small to show on the geologic map.
(4). Presence of a bedrock source for the placer gold in the headwaters of the drainage system which includes the massive sulfide, chromite, and gold vein deposits listed in table 1, locs. 13 and 15, occurrences shown on the map.

Areas F and C contain relatively small areas of ultramafic cumulates composed mostly of clinopyroxene with lesser amounts of olivine and orthopyroxene. Magmatic sulfides that are predominantly pyrrhotite, chalcopyrite, and pentlandite occur in some of these bodies and indicate potential for small deposits of nickel-copper-cobalt sulfides and also a chance for as yet unrecognized occurrences of cobalt-bearing arsenide deposits. Characteristics favorable for magmatic sulfide deposits are:

(1). The presence of mafic and ultramafic cumulates.
(2). Evidence for immiscible sulfide liquids which could have accumulated to form deposits.
(3). Widespread occurrences of disseminated sulfides in ultramafic cumulates indicating an abundance of mineralization in these rocks.

Characteristics that are unfavorable for economic concentrations of sulfides are:

(1). Economic concentrations of magmatic sulfides are scarce or are not known from ophiolites, suggesting that this environment is basically unfavorable for their occurrence.
(2). The occurrence of the ultramafic cumulates as small and dispersed bodies greatly restricts the number of favorable locations for economic sulfide deposits.
(3). Even in massive accumulations of these sulfides, the grades of nickel, copper, and cobalt are far below those now considered to be economic.

In areas F and C cobalt-bearing arsenide deposits occur in some ophiolite complexes mostly as veins. Most seem to have formed from internally derived metals that were remobilized by externally derived arsenic-bearing fluids that were introduced during serpentinization. Characteristics which suggest that deposits of this type could exist are:

(1). The availability of metals which the disseminated magmatic sulfides provide.
(2). The rocks are at least partially serpentinized.
(3). The conditions needed to form deposits of this type have occurred at least locally in this region as evidenced by the mineralization at the Cowboy mine which is located approximately 20 km east of the study area (Shenon, 1933).

Characteristics unfavorable for the formation of an economic cobalt-arsenide deposit are:

(1). Most rock has not been completely serpentinized.
(2). Vein deposits of this type, even when well developed, are usually small and are not economic.

REFERENCES CITED

Barnard, J. B., Page, N. J, Blakely, R. J., Ziemianski, W. P., Banister, C. A., and Gluesso, J. R., 1981, Map showing distribution of serpentine minerals, density, and magnetic susceptibility of rocks from the Kalmiopsis Wilderness, southwestern Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-1240-B, scale 1:62,500.
Blakely, R. J., Page, N. J, Senior, Lisa, Ryan, H. F., and Gray, Floyd, 1982, Maps showing aeromagnetic data and interpretation for the Kalmiopsis Wilderness, southwestern Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-1240-D , scale 1:62,500.
Brooks, H. C., and Ramp, Len, 1968, Gold and silver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 61, 338 p.
Carlson, C. A., Page, N. J, Grimes, D. J., and Leinz, R. W., 1982, Geochemical characteristics of rock samples from the Kalmiopsis Wilderness, southwestern Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-1240-C, scale 1:62,500.
Coleman, R. G., 1972, The Colebrook Schist of southwestern Oregon and its relation to the tectonic evolution of the region: U.S. Geological Survey Bulletin 1339, 61 p.
Gray, Floyd, 1980, Geology of the igneous complex of Tincup Peak, Kalmiopsis Wilderness area, southwestern Oregon: U.S. Geological Survey Open-File Report 80-1243, 65 p.
Hotz, P. E., 1971, Geology of lode gold districts in the Klamath Mountains, California and Oregon: U.S. Geological Survey Bulletin 1290, 91 p.
Page, N. J, Gray, Floyd, Cannon, J. K., Foose, M. P., Lipin, Bruce, Moring, B. C., Nicholson, S. W., Sawlan, M. G., Tilt, Alison, and Ziemianski, W. P., 1981, Geologic map of the Kalmiopsis Wilderness area, Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-1240-A, scale 1:62,500.
Page, N. J, and Johnson, M. G., 1977, Chromite resources of podiform chromite deposits and exploration for concealed chromite deposits in the Medford-Coos Bay quadrangles, southwestern Oregon: U.S. Geological Survey Open-File Report 77-565, 14 p.
Page, N. J, Johnson, M. G., Wafftry, Joseph, and Ramp, Len, 1975, Occurrence of platinum-group metals in ultramafic rocks of the Medford-Coos Bay 2° quadrangle, southwestern Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-694, scale 1:250,000.
Ramp, Len, 1961, Chromite in southwestern Oregon: Oregon Department of Geology and Mineral Industries Bulletin 52, 169 p.
_____1975, Geology and mineral resources of the upper Chetco drainage area, Oregon, including the Kalmiopsis Wilderness and Big Craggies Botanical areas: Oregon Department of Geology and Mineral Industries Bulletin 88, 47 p.
_____1978, Investigations of nickel in Oregon: Oregon Department of Geology and Mineral Industries Miscellaneous Paper 20, 68 p.
Ramp, Len, and Peterson, N. V., 1979, Geology and mineral resources of Josephine County, Oregon: Department of Geology and Mineral Industries Bulletin 100, 45 p.
Singer, D. A., Cox, D. P., and Drew, L. J., 1975, Grade and tonnage relationships among copper deposits: U.S. Geological Survey Professional Paper 907-A, 11 p.
Shenon, P. J., 1933, Geology and ore deposits of the Takilma-Waldo district, Oregon, including the Blue Creek district: U.S. Geological Survey Bulletin 846, p. 141-194.
Solomon, M., 1976, "Volcanic" massive sulfide deposits and their host rocks--a review and explanation, in Wolf, K. H., ed., Handbook of stratabound and stratiform ore deposits: Co, Zn, and Ag deposits: New York, Elsevier, v. 6, p. 21-54.
Wells, F. G., Hotz, P. E., and Cater, F. W., Jr., 1949, Preliminary description of the geology of the Darby quadrangle, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 40, 23 p.

[1] U.S. Geological Survey
[2] U.S. Bureau of Mines

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Explanatory pamphlet accompanies map