DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP MF-1240-E

MINERAL RESOURCE POTENTIAL OF THE KALMIOPSIS WILDERNESS, SOUTHWESTERN OREGON

By Norman J Page[1] and Michael S. Miller[2]

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Kalmiopsis Wilderness, Siskiyou National Forest, Josephine and Curry Counties, Oregon. The area was established as a wilderness by Public Law 88-577, September 1964.

INTRODUCTION

Location

The Kalmiopsis Wilderness is in southwestern Oregon immediately north of the California border (fig. 1) in the Klamath Mountains geomorphic province and comprises the southwestern parts of Josephine County and parts of southeastern Curry County. The 168,900-acre wilderness in the Siskiyou National Forest includes most of the headwater basin of the Chetco River, parts of headwaters of the Smith River, and sections of the Illinois River drainage system. The two major access routes are by the Eight Dollar Mountain Road to Onion Camp, originating near Highway 199 near Kerby, and from Brookings on U.S. Highway 101 via Quail Prairie to Vulcan Peak. Other access routes include the Wimer Road to Sourdough Camp, originating in O'Brien on Highway 199, and the Illinois River road to Chetco Pass, originating on Highway 199 near Selma.

Geologic setting

The general structural pattern of the Klamath Mountains province tectonically juxtaposes island-arc metavolcanic rocks of the Western Jurassic belt (Irwin, 1966; Hotz, 1971), broken and dismembered ultramafic and mafic rocks of ophiolite sequences, graywackes, and shales of the Upper Jurassic and Lower Cretaceous Dothan Formation, and granitic plutonic rocks of Late Jurassic and Early Cretaceous age. Such a complex geologic environment suggests the possibility of deposits of the following commodities: copper, zinc, lead, gold, silver, mercury, chromium, nickel, cobalt, manganese, iron, platinum-group metals, asbestos, and talc. Indeed, joint studies by the U.S. Geological Survey and U.S. Bureau of Mines (Page and others, 1981b) have identified the potential for the occurrence of mineral deposits of some of these commodities in subareas within and immediately adjacent to the Kalmiopsis Wilderness.

Mining activity

Placer and lode mining in the Kalmiopsis area probably began at least as early as the 1870's. Initially, precious metals and copper were mined. Mining of the industrial metals, such as chromium, increased after 1910. Copper, iron, nickel, manganese, cobalt, and platinum production from the Kalmiopsis Wilderness has been negligible or very small (Ramp, 1975). Recorded metal production from the Kalmiopsis and adjacent or nearby mining areas is shown in table 1 (pamphlet). About 59,000 short tons (53,500 t) of chromite have also been produced from the six mining areas considered in the table.

Miners were producing gold from placers along the Little Chetco and Chetco Rivers in the late 1970's and early 1980's. Active exploration and assessment work were being performed on lode claims near Collier Creek (in the northwestern part of the wilderness), near Pearsoll Peak, near Emily Cabin (in the east-central part of the wilderness), and near The Oaks (at the south end of the wilderness).

GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS PERTAINING TO MINERAL RESOURCE ASSESSMENT

Recent geologic, geochemical, and geophysical field and laboratory studies (Page and others, 1981a; Grimes and Leinz, 1981; unpub. data; Barnard and others, 1981; Blakely and others, 1981; Carlson and others, 1981; and Gray, 1980) and previous studies by Ramp (1961, 1975, 1978) and Wells and others (1949) have allowed the areal distribution and characteristics pertinent to mineral resource assessment to be delineated in the structurally complex set of thrust fault plates jumbled by normal faulting. These studies show that the western portion of the Kalmiopsis Wilderness is underlain by the Dothan Formation with thrust plates of dismembered ophiolitic rocks emplaced over it; in the western part of the area only remnants of these plates, such as the Big Craggies, remain due to erosion. The presence of graywacke, mudstone, siltstone, and shale deposited in deep water and the absence of significant geochemical anomalies suggest a low probability of the occurrence of metallic lode deposits in this area. The thrust plate of dismembered ophiolitic rocks is exposed to the east of the Dothan Formation and contains ultramafic rocks that possibly contain deposits of podiform chromite and have nickel-cobalt-chromium-enriched lateritic deposits developed on the surfaces. No extensive areas containing talc, asbestos, or platinum-group metal deposits were identified. The gabbroic rocks of the ophiolite sequences contain minor occurrences of iron sulfides and concentrations of magnetite (iron); there are some unexplained geochemical copper anomalies in drainages from these rocks. The central, eastern part of the Kalmiopsis area is underlain by faulted slices of island-arc volcanic rocks of Jurassic age which consist of mafic to felsic calc-alkaline flows and

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

subaqueous pyroclastic rocks interbedded with lensoidal volcanogenic graywacke, siltstone, and shale. Within this sequence are small, irregular, sheared stratabound lenses of pyritic sulfide with or without magnetite and containing copper, zinc, silver, and gold. Geochemical anomalies of copper, zinc, lead, and mercury suggest the presence of other deposits of this type that are not exposed at the surface. Quartz veins occurring in these highly fractured volcanic and ultramafic rocks contain gold and copper. Erosion, beginning in Tertiary time, produced fossil beach placers northeast of Horse sign Butte and, in the Quaternary, produced terrace gravels and alluvial deposits containing placer gold in the Little and main Chetco River drainages.

MINING DISTRICTS AND MINERALIZATION

China Diggings, Chetco, Gold Basin, Tincup Creek, Collier Creek, Illinois River, and Smith River are names of historic mining districts in and near the wilderness. These vaguely defined districts have been incorporated into what have been called mining areas (Oregon Dept. Geology and Mineral Industries, 1943). The Kalmiopsis Wilderness includes parts of the Agness, Chetco, and Illinois River mining areas (table 1). The Waldo mining area is adjacent, while the Gold Beach and Galice are nearby. Lode, placer, and laterite deposits were considered separately in this study.

More than 900 claim and water-right locations in the Kalmiopsis Wilderness have been recorded in Curry and Josephine Counties. Many were claim relocations. About one-third were staked on placer deposits; two placer claims, in Gold Basin, were patented in 1898. Fewer than 20 percent of the claims were actively held in 1978.

Mineral localities are (1) near Collier Creek (nickel laterite and massive sulfides), (2) near Chetco Pass (nickel laterite and chromite), (3) between Chetco Pass and Doe Gap (massive sulfides, precious metals in quartz veins and shear zones), (4) in the Gardner Claim area (podiform chromite), (5) near The Oaks (chromite and nickel laterite), and (6) along the Little Chetco River and parts of the Chetco River and tributaries (placer gold).

The Kalmiopsis Wilderness is underlain by folded and faulted metamorphic, volcanic, granitic, mafic, and ultramafic rocks. Economic minerals are found locally along sheared contacts between serpentinite and mafic rocks, metavolcanic rocks, or metasedimentary rocks. Quartz veins associated with the contacts may also be mineralized. Ultramafic rocks contain chromite, and some metavolcanics contain sulfide minerals. Laterites, containing nickel, overlie ultramafic rocks; some placer gold has been found.

Lode Claims

Lode claims are located mainly near Pearsoll Peak, Emily Cabin, The Oaks, Tincup Peak, the Big Craggies, and Hurt Cabin.

Most claims, prospects, and mines are concentrated in the east-central part of the wilderness, near Pearsoll Peak and Emily Cabin. Production from major mines in, or within about 2 mi (3.2 km) of this part of the wilderness, is estimated to have been at least 7,000 troy ounces (220,000 g) of gold and about 4,000 long tons (4,100 t) of chromite. At the time of this study, assessment work, small-scale mining, or exploration was being done at the Pearsoll Peak mine, Pearsoll Group, Prospectors Dream, Found Again, Wonder, B. and C., Bowser, Robert E., and Peck deposits.

Lode claims and mineral deposits are scattered throughout the south and southwestern parts of the Kalmiopsis Wilderness, near The Oaks. Chromite, nickel laterite, and magnanese claims predominate. At least 1,500 short tons (1,400 t) of chromite ore have been mined from the Baldface mine. The chromite is in a sheared, possibly discontinuous lens-shaped layer. Chromite was also produced from the Gardner claim area.

An area of sparse lode claims is near Tincup Peak and the Big Craggies, between the Illinois and the Chetco Rivers. Magnetite has been segregated in metagabbro and pyroxenite near the Big Craggies and at active claims at Tincup Peak. Dark igneous rocks of the type cropping out in the Tincup-Big Craggies area are favorable for gold, platinum, copper, and iron deposits.

A group of mineral deposits and claims is near Collier Creek, in the northwest corner of the Kalmiopsis Wilderness. Metavolcanic rocks and dark intrusive rocks, especially at the contacts with serpentinite, are favorable for gold, silver, and copper. Some sedimentary rocks contain concentrations of magnetite. A few tens of tons of copper ore have been produced from the Hurt Cabin deposit (Butler and Mitchell, 1916). There have been active claims on the Hurt Cabin claim and on the Horse Sign Butte iron deposit.

Placer deposits

Most Kalmiopsis gold placers are along streams flowing through or from areas with lode minerals. Major placers are along the Chetco River and its tributaries. Placers, such as those along the Chetco and Little Chetco Rivers, initially lured miners to the Kalmiopsis area; placer mining occurred prior to 1870. The quantity of placer gold production in the early days is unknown but is estimated to have been hundreds of ounces. Recent gravel, bench gravels, old erosion surfaces, and alluvial deposits have all been mined.

In 1979, placer claims and small-scale placer mining were known along the Chetco River, the Little Chetco River, Carter Creek, Babyfoot Creek, and Slide Creek.

Laterite deposits

Laterites are found in the south, east, and northern parts of the wilderness. Interest in laterites has been greatest since 1950. Large groups of claims, some overlapping, have been staked.

Laterites occur as small scattered patches on gentle slopes overlying broken weathered ultramafic rocks. Nickel, chromite, copper, and cobalt content depend on composition of the parent rock and weathering conditions. Boulder-free lateritic soils contain the highest values. Most laterites are rocky; their grades could be improved by selective mining.

In 1979, laterite claims were located in the Collier Creek area (at the north end of the wilderness) and near Chetco Pass (in the east-central part of the wilderness). Previously, claims had been staked along Baldface Ridge at the south end of the wilderness.

Resource estimates

The wilderness, and areas within about 2 mi (3.2 km), are estimated to contain inferred marginal reserves and subeconomic resources (U.S. Bureau of Mines and U.S. Geological Survey, 1980) of about 40,000 troy ounces (1,200,000 g) of gold, 2,000,000 troy ounces (60,000,000 g) of silver, 10,000,000 pounds (4,500,000 kg) of nickel, and 70,000,000 pounds (32,000,000 kg) of chromium. Details are given in table 2.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Based on joint studies between the U.S. Bureau of Mines and the U.S. Geological Survey, the subareas within and immediately adjacent to the Kalmiopsis Wilderness have potential for the occurrence of mineral deposits which were not necessarily economic in 1981. The geologic, geochemical, and geophysical characteristics favorable for the occurrence of certain types of deposits are evaluated in this section and the areas are delineated on figure 2. No geologic, geochemical, or geophysical evidence was found to suggest the occurrence of economic deposits of talc, asbestos, manganese, mercury, or platinum-group elements, and the potential for resources of these commodities is considered low. Although iron occurs as magnetite concentrations up to 25 percent in mafic rocks in the Kalmiopsis Wilderness area, there are no extensive geophysical magnetic anomalies associated with the occurrences, which indicates noneconomic volumes and grades of this type of deposit. The identified resources of iron in fossil beach sands appear too small to be economic in the near future.

Environmental, legal, access, and climatic conditions would inhibit the orderly development of any mineral deposit in the study area. Rapid metals price fluctuations could adversely affect mining.

Volcanogenic Deposits

Characteristics necessary for the occurrence of economic volcanogenic deposits containing copper, zinc, lead, silver, and gold in the Kalmiopsis Wilderness are tabulated and evaluated below; details of the characteristics are given by Page and others (1981b).

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Occurrence of stratabound lenses of pyrite or other sulfides with base metals in clusters with intragroup spacings of a few kilometers	yes
2. Low-grade disseminated sulfides, vein mineralization, and hydrothermal alteration generally stratigraphically related to stratabound lenses	yes
3. Tonnages of 100,000 to 100,000,000 metric tons and respective grades of about 10 and 1 percent copper	possibly
4. Presence of mafic to felsic calc-alkaline volcanic rocks of pyroclastic, subaqueous origin interbedded with immature volcanogenic graywacke, siltstone, shale, chert, and siliceous tuff in an island-arc environment	yes
5. Geochemically anomalous amounts of copper, zinc, lead, mercury, and manganese in stream sediments	yes
6. Simple geology with limited faulting and folding	no
7. Abundance of rhyodacitic and rhyolitic rocks in the volcanic sequence	no
8. Permit inexpensive mining and milling	partially

Podiform Chromite Deposits

Below is the evaluation of the characteristics necessary for the occurrence of economic podiform and disseminated chromite deposits.

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Occurrence of podiform and disseminated chromite deposits	yes
2. Presence of ultramafic rocks of an ophiolitic sequence that contains extensive areas of dunite tectonites and cumulates	partially
3. Tonnages of previously mined chromite deposits range from a few kilograms to 32,430 metric tons with an average size of 206 metric tons and grades between 43 and 51 percent Cr_2O_3; however, in the 1981 economy a deposit or closely clustered group should have at least 100,000 metric tons and grades of 43 percent or greater Cr_2O_3	no
4. Large unfaulted and unsheared blocks of ultramafic rocks	partially
5. Permit inexpensive mining and chromite recovery	partially

Laterite Deposits

Evaluation of the necessary characteristics for the occurrence of laterite economic deposits containing nickel, cobalt, and chromium is tabulated below.

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Occurrence of nickel, cobalt, and chromium in laterite deposits	yes
2. Presence of nickel-, cobalt-, and chromium-enriched parent ultramafic rocks with developed lateritic soils	yes
3. Relatively flat areas of topography developed on ultramafic rocks during a period of lateritic soil formation	yes
4. Tonnages upward of 10,000,000 metric tons and nickel grades in excess of 0.65 percent in an individual or closely grouped set of deposits	no
5. Homogeneous grades without large lateral and vertical changes in the deposit	partially
6. A metallurgical process capable of extracting metals from chemically and mineralogically diverse soils	yes

Lode Gold Deposits

Characteristics favorable for the occurrence of economic vein lode gold deposits are evaluated below.

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Occurrence of lode gold in quartz veins	yes

2.	Presence of favorable host rocks including metavolcanic rocks and serpentine	yes
3.	Presence of rocks broken up by faults along which gold-containing quartz veins may be deposited	yes
4.	Mercury and copper geochemical anomalies associated with fractured rocks	yes
5.	Presence of quartz veins on the surface with hydrothermal circulation patterns superimposed on volcanic and ultramafic rocks	possibly
7.	Tonnages of 50,000 to 1,000,000 and respective grades of 1 to 0.2 ounces of gold per ton	partially
8.	Continuity of deposits	partially
9.	Inexpensive mining and gold recoverable	partially

Placer Gold Deposits

An evaluation of the characteristics favorable to the economic occurrence of placer gold deposits is tabulated below.

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Presence of known resources of placer gold	yes
2. Occurrence of recent and bench deposits	yes
3. Presence of lode sources for gold in the headwaters of the stream drainages with alluvial deposits	yes
4. Yardages of 1,000 to 1,000,000 and respective grades of 0.05 to 0.002 ounces of gold per cubic yard	possibly
5. Available water	partially
6. Suitability for mining and sluicing	partially
7. Gold recoverability	yes

Magmatic Sulfide Deposits

Evaluation of the characteristics for the occurrence of economic magmatic nickel-copper-cobalt sulfide deposits are tabulated below.

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Occurrence of ultramafic and mafic cumulates	yes
2. Occurrence of concentrations of magmatic sulfides	yes
3. Occurrence of combined Ni+Cu+Co grades in excess of 0.5 percent	probably not
4. Occurrence of tonnages in excess of 5,000,000 tons	probably not

Cobalt Vein Deposits

Evaluations of the characteristics for the occurrence of cobalt-bearing arsenides in vein deposits are tabulated below.

Characteristics	Conditions met in the Kalmiopsis Wilderness
1. Ultramafic rocks which could provide a source for cobalt	yes
2. Extensive serpentinization of the ultramafic rocks to provide the environment for metal remobilization	partially
3. A source for arsenic	unknown
4. Identified occurrences of this type of mineralization	none

REFERENCES CITED

Barnard, J. B., Page, N. J, Blakely, R. J., Ziemianski, W. P., Banister, C. A., and Giusso, 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, Map 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.

Butler, G. M., and Mitchell, G. J., 1916, Preliminary survey of the geology and mineral resources of Curry County, Oregon: Oregon Bureau of Mines and Geology, v. 2, no. 2, 134 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.

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.

Irwin, W. P., 1966, Geology of the Klamath Mountains province, in Bailey, E. A., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 19-38.

Oregon Department of Geology and Mineral Industries, 1943, Oregon metal mines handbook; Coos, Curry, and Douglas Counties: Bulletin 14-C, v. 1, 133 p.

Page, N. J, Gray, Floyd, Cannon, J. K., Foose, M. P., Lipin, Bruce, Moring, B. C., Nicholson, S. W., Sawlin, M. G., Till, Alison, and Ziemianski, W. P., 1981a, Geologic map of the Kalmiopsis Wilderness area, Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-1240-A, scale 1:62,500.

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.

U.S. Bureau of Mines and U.S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U.S. Geological Survey Circular 831, 5 p.

Wells, F. G., Hotz, P. E., and Cater, F. W., Jr., 1949, Preliminary description of the geology of the Kerby quadrangle, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 40, 23 p.

Table 1.--Metals production by mining areas in or near the Kalmiopsis Wilderness

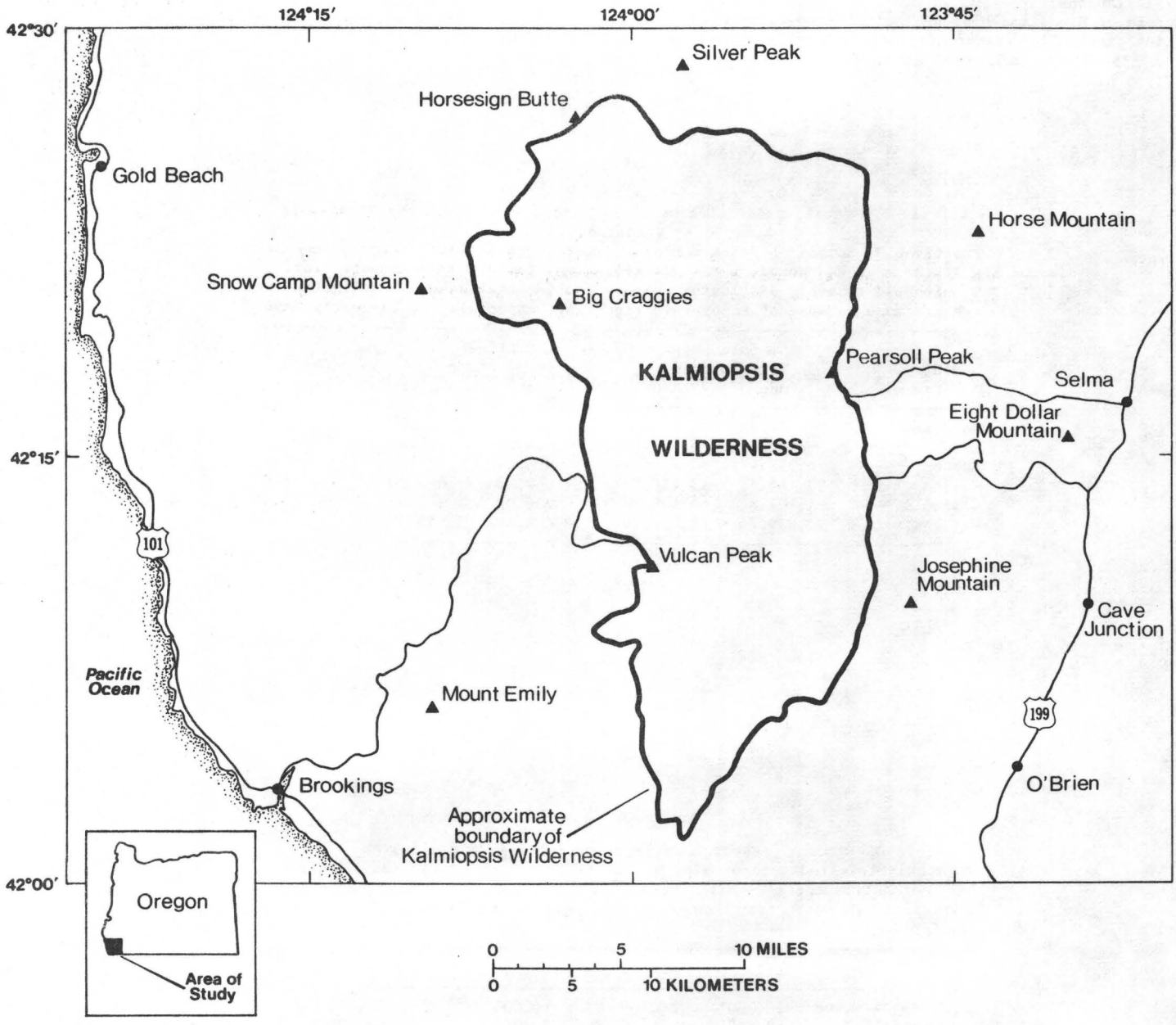
[Mostly U.S. Bureau of Mines records. Metric conversions: troy ounces x 31.103 = grams; pounds x 0.453 = kilograms; ton x 0.9072 = metric ton. W, withheld to avoid disclosing company confidential data. The figures are minimums because of incomplete reporting, especially in the early days]

Mining area	Gold (troy ounces)		Silver (troy ounces)		Copper (pounds)
	Lode	Placer	Lode	Placer	
Gold Beach --	34.75	621.46	5.00	27.00	--
Agness ------	65.4	420.8	14.00	301.00	--
Chetco ------	6,319.47	808.04	964.00	127.00	--
Galice ------	29,486.31	15,424.90	51,664.00	1,648.00	295,951.00
Illinois ----	1,197.84	10,400.71	239.00	915.00	9,400.00
Waldo	13,879.70	43,007.79	8,604.40	3,853.00	W

Table 2.--Mineral resource estimates for the Kalmiopsis area (mostly inferred subeconomic, M. S. Miller, unpub. data, 1980)

[--, not estimated; $x10^6$=million; $x10^8$=100 million; $x10^9$= billion. Metric conversions: troy ounces x 31.103=grams; pounds x 0.453=kilograms]

	Lode	Placer	Laterite	Total
Gold (oz) ------	10,000	20,000	10,000	40,000
Silver (oz) ----	$2x10^6$	--	50,000	$2x10^6$
Copper (lb) ----	$1x10^6$	--	20,000	$1x10^6$
Zinc (lb) ------	$10x10^6$	--	--	$10x10^6$
Manganese (lb) -	30,000	--	--	30,000
Nickel (lb) ----	--	--	$10x10^6$	$10x10^6$
Chromium (lb) --	$30x10^6$	--	$40x10^6$	$70x10^6$
Cobalt (lb) ----	100,000	--	$4x10^6$	$4x10^6$
Iron (lb) ------	$6x10^9$	--	$7x10^8$	$7x10^9$
Vanadium (lb) --	$3.5x10^6$	--	--	$3.5x10^6$
Titanium (lb) --	$3x10^6$	--	--	$3x10^6$



Index map of Kalmiopsis Wilderness and surrounding area

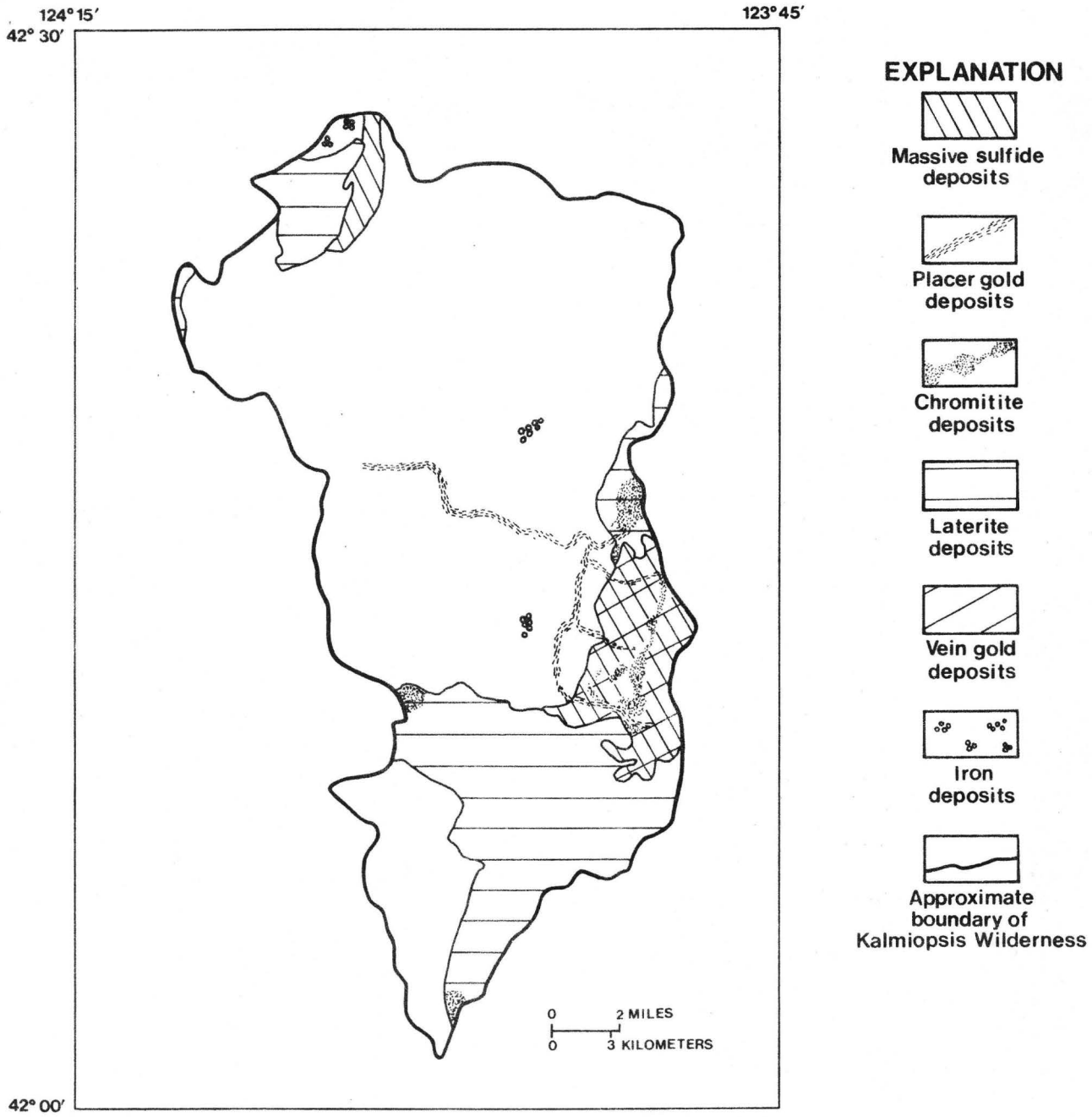


Figure 2.--Location of areas in the Kalmiopsis Wilderness with geologic, geochemical, and geophysical characteristics favorable for the occurrence of certain types of deposits.