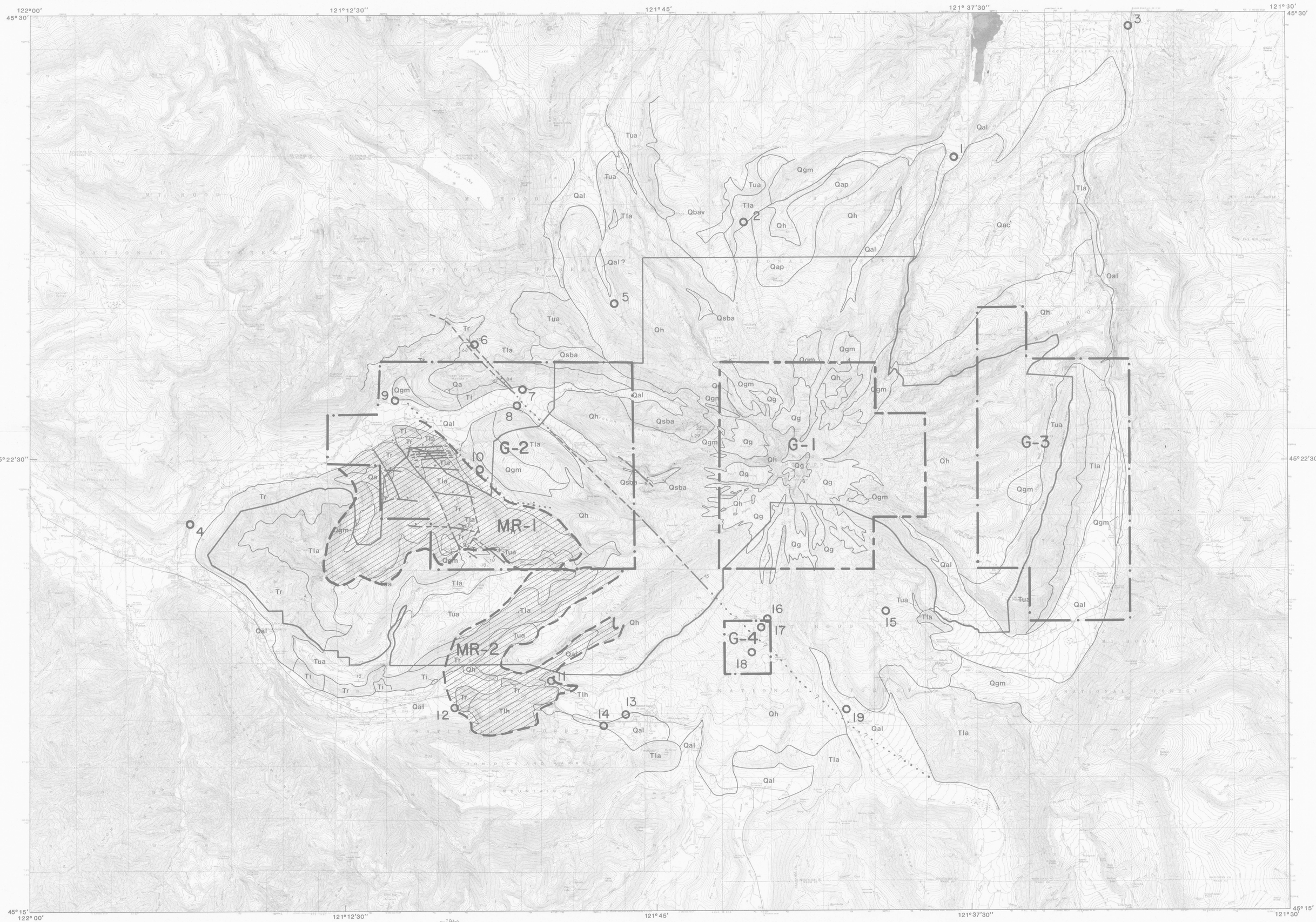
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1379-E



Base from U.S. Geological Survey 1:24,000
Badger Lake, Bull Run Lake, Cathedral Ridge,
Dog River, Government Camp, Hickman Butte,
Mount Hood South, Rhododendron, 1962

TRUE NORTH
19½°
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1982

SCALE 1:62 500

1 ½ 0 1 2 3 4 5 MILES
1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

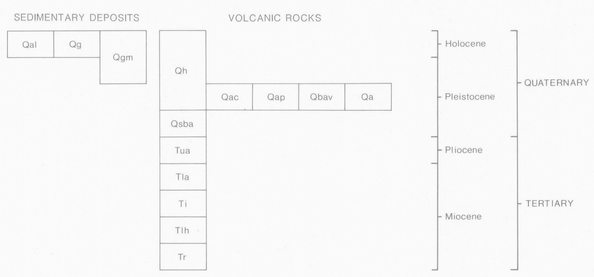
AREA OF MAP

Geology mapped by W.S. Wise, 1968, 1969;
T.E.C. Keith, M.H. Beeson, K.E. Bargar,
1979, 1980; H.J. Meyer, J. Hook, M.W.
Gannet, 1980.

EXPLANATION

- CONTACT--approximately located
- FAULT-showing dip; dashed where approximately located; dotted where uncertain. Bar and ball on downthrown side.
- 29 STRIKE AND DIP OF LAVA FLOWS AND BEDDING IN VOLCANICLASTIC LAYERS
- BOUNDARY OF MOUNT HOOD WILDERNESS
- MR-1 MINERAL-RESOURCE POTENTIAL AREA
- G-1 BOUNDARY OF KNOWN GEOTHERMAL RESOURCES AREA
- GEOTHERMAL-RESOURCE POTENTIAL AREA: area of geothermal lease by industry.
- 14 GEOTHERMAL DRILL HOLE LOCATION AND NAME

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SEDIMENTARY DEPOSITS

Qal ALLUVIUM (HOLOCENE)--Unconsolidated stream deposits

Qg GLACIERS (HOLOCENE)--Presently active ice bodies

Qgm GLACIAL MORAINES (HOLOCENE AND PLEISTOCENE)--Unsorted and poorly indurated glacial deposits

VOLCANIC ROCKS

Qh LAVAS OF MOUNT HOOD (HOLOCENE AND PLEISTOCENE)--Undifferentiated andesite flows and dacitic pyroclastic rocks of Mount Hood volcano

Qac ANDESITE OF THE CLOUD CAP (PLEISTOCENE)--Medium- to dark-gray andesite flows from vent at Cloud Cap

Qap ANDESITE OF THE PINNACLE (PLEISTOCENE)--Medium- to dark-gray andesite flows from vent at The Pinnacle

Qbav ANDESITE AND BASALT OF VISTA RIDGE (PLEISTOCENE)--Medium- to dark-gray olivine andesite flows from several vents along Vista Ridge. Dark-gray to black aphanitic basalt from Vista Ridge including red scoriaceous basalt from the cinder cone at Red Hill

Qa UNDIFFERENTIATED ANDESITES FROM SATELLITIC VENTS (PLEISTOCENE)--Medium- to dark-gray microporphyritic olivine andesite flows

Qsba SANDY GLACIER VOLCANO (PLEISTOCENE)--Black to dark-gray olivine basalt flows, pyroxene and hornblende andesite flows, and interlayered tuffs and breccias forming a partly exposed and dissected cone on the west side of Mount Hood

Tua UPPER ANDESITE FLOWS (PLIOCENE)--Medium-gray microporphyritic olivine andesite flows

Tla LOWER ANDESITE FLOWS (MIOCENE)--Light- to medium-gray olivine and pyroxene andesite flows with interlayered tuffs and breccias; characterized in places by coarse porphyritic hypersthene andesite

Ti INTRUSIVE ROCKS (MIOCENE)--Medium-gray andesite plugs

Tlh QUARTZ DIORITE OF LAUREL HILL (MIOCENE)--Medium-grained quartz diorite and quartz monzonite intrusion

Tr RHODODENDRON FORMATION (MIOCENE)--Varicolored volcaniclastic rocks and andesite lava flows

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 Mount Hood Wilderness, in the Mount Hood National Forest, Clackamas and Hood River Counties, Oregon. The Mount Hood Wilderness was established as a Primitive Area in 1931, and reclassified as a wilderness on June 27, 1940.

SUMMARY

During 1979 and 1980 the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations in the Mount Hood Wilderness and surrounding area to evaluate the mineral and geothermal resource potential of the wilderness. Field studies included geologic mapping, geochemical sampling, geophysical surveys, and a survey of known prospects and mineralized areas. Exploratory geothermal drilling financed by the U.S. Department of Energy, U.S. Geological Survey, Oregon Department of Geology and Mineral Industries, and Northwest Geothermal Corporation has been done just outside the wilderness. Approximately 8,960 acres (3,626 ha) within the wilderness have been declared a Known Geothermal Resources Area (KGRA) by the U.S. Geological Survey, and 9,600 acres (3,885 ha) of the wilderness are included in geothermal leases.

Low potential exists for silver, lead, zinc, copper, and gold associated with vein-type and porphyry-type mineralization in the west part of the wilderness. Sparse amounts of sulfide in thin, discontinous quartz-filled veins, and a propylitically altered quartz diorite pluton with associated quartz-calcite-epidote-zeolite-filled veins at the contact zone are sufficient to cause geochemical anomalies but are not sufficiently abundant to be a mineral resource.

A moderate to high potential exists for a low- to intermediate- temperature (less than 248°F, 120°C), hot-water-type geothermal resource within the wilderness.

GEOLOGY

The Mount Hood Wilderness is located along the crest of the High Cascade Range which extends from northern California to British Columbia. The High Cascade Range is characterized by Pleistocene and Holocene volcanic activity, the major topographic features of which are large, predominantly andesitic stratovolcanoes. These volcanic rocks were extruded onto a parallel, eroded range of older Cenozoic, dominantly andesitic volcanoes that are presently referred to as the western Cascade Range. Mount Hood is one of the large, dominantly andesitic stratovolcanoes and is considered active because of reported ash events in 1859 and 1865, and because fumaroles are active in the 200- to 300-year-old vent and dome area (Crater Rock).

Zigzag Mountain, which constitutes the western part of the wilderness, is composed of lava flows and pyroclastic rocks erupted prior to the building of Mount Hood volcano and is considered to be part of the western Cascade Range.

All the rocks exposed in the wilderness are of Tertiary and Quaternary age, and of volcanic origin. The oldest rocks are upper Miocene andesitic lava flows and volcaniclastic rocks of the Rhododendron Formation. Hydrothermal alteration in the Rhododendron is significant in the Lost Creek-Burnt Lake-Cast Creek-Short Creek drainage areas where thin, discontinous, sulfide-bearing quartz veins occur, and at the contact zone with the quartz diorite pluton of Laurel Hill. The pluton is of late Miocene age and appears to be part of a pluton complex which extends north beneath the rocks of Zigzag Mountain.

Andesitic lava flows from several vents were extruded over the Rhododendron Formation at the end of the Miocene. Small, propylitically altered plugs which were feeder vents to the flows crop out in the vicinity of Zigzag Mountain.

Volcanic activity during the Pliocene was similar to that of the late Miocene in that several small vents produced local andesitic lava flows. The Pliocene lavas are petrographically similar to the older andesite, but they are generally unaltered and not fractured.

A large basaltic to andesitic volcano, the Sandy Glacier volcano, grew during the Pleistocene and is exposed below the west flank of Mount Hood volcano. More than one similar large Pleistocene volcano may have been buried by the lava flows of Mount Hood volcano.

Mount Hood volcano began building up less than 730,000 years ago by extrusion of andesitic lava flows. This activity ceased about the time of the Fraser Glaciation, 15,000 years ago. Three major periods of pyroclastic eruptions, mudflows, and dome extrusion of hornblende dacite have characterized Mount Hood activity during the last 12,000 years (Crandell, 1980). Fumaroles have been continuously active around the youngest dome (Crater Rock), which was emplaced about 200 to 300 years ago. Minor ash eruptions were reported in 1859 and 1865.

The general structural patterns in rocks of the wilderness area trend east-northeast and north-northwest, which are directions typical of rocks in the Cascade Range.

GEOCHEMISTRY

Geochemical sampling shows anomalous concentrations of silver, lead, and zinc on the north side of Zigzag Mountain in the area of Burnt Lake and including the drainages of Lost Creek, Cast Creek, Short Creek, and Horseshoe Creek (MR-1). Thin, discontinous quartz veins containing sparse amounts of pyrite, chalcopyrite, galena, and sphalerite occur along Lost Creek, and quartz-sulfide veins fill small steeply dipping faults exposed in the propylitically altered Rhododendron Formation in the area.

Anomalous concentrations of silver, lead, and zinc also occur in the Lady Creek drainage on the south side of Zigzag Mountain (MR-2). The quartz diorite of Laurel Hill crops out at the south end of Lady Creek about 0.6 mi (1 km) outside the wilderness. The propylitically altered contact zone of the quartz diorite and Rhododendron Formation at the western end of Laurel Hill contains subvertical thin quartz veins with sparse sulfides and copper silicate minerals. Anomalous concentrations of gold and copper as well as lead, zinc, and silver are found locally in vein material at the contact zone.

Geochemical anomalies in both areas are a result of epithermal mineralization. The area on the north side of Zigzag Mountain is best interpreted as having vein-type silver-lead-zinc mineralization typical of Cenozoic andesitic volcanism as described by Boyle (1979) and Sillitoe (1977, 1981). Vein-type epithermal deposits, all of which are probably associated with nearby small intrusive bodies, are found in several places along the western Cascade Range (Callaghan and Buddington, 1938). A few of the larger deposits have been mined for gold, but most appear to be small and not of ore grade.

The Lady Creek anomalies may be related to vein-type deposits, but they more likely are related to porphyry-type mineralization from the quartz diorite of Laurel Hill. Porphyry-type mineralization is found in many parts of the western Cascade Range, but producing deposits have been located only in the larger, more deeply eroded plutons of British Columbia (Field and others, 1974; Hollister, 1978).

Although the Zigzag Mountain area contains epithermal mineralization, the veins are thin, short, and discontinuous, and the base and precious metal-bearing minerals are sparse.

GEOPHYSICS

Geophysical data support field observation and interpretations (Williams and Keith, 1982). Flanagan and Williams (1982) interpret the aeromagnetic data as indicating several volcanic cones, similar to Sandy Glacier volcano, buried under the flanks of Mount Hood.

Gravity data indicate a dense intrusive body 3 mi (5 km) in diameter beneath Mount Hood volcano (Williams and Keith, 1982). The body extends into the edifice of the volcano where it appears to decrease in size to a diameter of 0.6 mi (1 km). Gravity data also show a low over Zigzag Mountain and Laurel Hill which can be interpreted as a pluton complex more extensive at depth than surface outcrops indicate.

Electromagnetic and magnetotelluric data are interpreted by Goldstein and others (1981) as revealing buried intrusive bodies beneath the south and southeast flank of Mount Hood volcano.

GEOTHERMAL INVESTIGATIONS

Geothermal heat sources may be (1) the magma chamber of the Mount Hood volcano as reflected in the active fumarole area near the top of Mount Hood (Robison and others, 1982) and (2) a high regional heat flow and geothermal gradient (Blackwell and Steele, 1979). A large portion of Mount Hood volcano, including approximately 8,960 acres (3,626 ha), was declared a Known Geothermal Resources Area (G-1). Geothermal leases have been issued in the Old Maid Flat (G-2), Bluegrass Ridge (G-3) Timberline Lodge (G-4), and areas, including approximately 9,600 acres (3,885 ha) within the wilderness. Two of the deepest geothermal exploration holes were drilled adjacent to the wilderness west of Mount Hood; Old Maid Flat 1 (OMF 1) reached a temperature of 180°F (82°C) at a depth of 4,003 ft (1,220 m), and Old Maid Flat 7A (OMF 7A) reached 235°F (113°C) at a depth of 6,028 ft (1,838 m). Both had poor permeability and yielded inadequate quantities of water for a geothermal resource. Pucci drill hole, just outside the wilderness on the south flank of Mount Hood, reached a temperature of 170°F (76.7°C) at a depth of 3,706 ft (1,130 m). The well was tested briefly during the summer 1981, yielding a water flow of 110 gallons per minute; the area may be considered for production of hot water for space heating of the new Timberline Day Lodge.

ECONOMIC EVALUATION

Low potential exists for silver, lead, zinc, gold, and copper associated with vein-type and porphyry-type mineralization in the west part of the wilderness. Moderate to high potential for low- to intermediate-temperature (less than 248°F, 120°C), hot-water geothermal resource exists within the wilderness.

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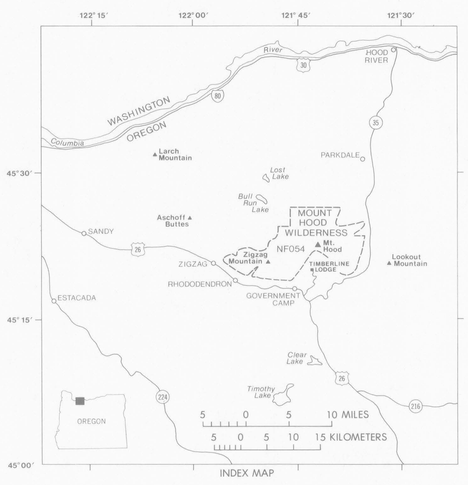

Table 1. Areas with geochemical anomalies.

Area	Potential	Type of Mineralization	Evidence for Resource
MR-1 Lost Creek-Burnt Lake-Short Creek-Cast Creek	Low	Vein	a. Geochemical sampling had anomalous amounts of Ag, Pb, Zn. b. Minor amounts of galena, sphalerite, chalcopyrite, and pyrite included in quartz veins. c. Thin, pinching and swelling, discontinuous quartz veins in andesitic lava flows and volcaniclastic rocks. d. Propylitic alteration of host andesitic lava flows and volcaniclastic rocks.
MR-2 Lady Creek-Laurel Hill	Low	Porphyry	a. Outcrop of late Miocene quartz diorite to quartz monzonite pluton. b. Geochemical sampling had anomalous amounts of Ag, Pb, Zn, Cu, Au. c. Propylitic alteration of pluton and adjacent volcaniclastic rocks of the Rhododendron Formation. d. Minor amounts of chalcopyrite and secondary copper minerals in quartz-calcite-epidote-zeolite-filled fractures.

Table 2. Areas with geothermal potential.

Map	Designation	Potential	Type of System	Evidence for Resource
G-1	Known Geothermal Resources Area	Moderate	Hot water approx. 248°F (120°C) (minor vapor-dominated)	a. Active fumaroles at crater of Mount Hood volcano. b. Temperatures measured as high as 194°F (90°C). c. Volcano should provide long-term heat source. d. Brook and others (1979) estimate reservoir temperature of 122°C for hot-water geothermal system.
G-2	Geothermal lease area	Moderate to High	Hot water less than 212°F (100°C)	a. Several drill holes in this area have yielded favorable temperatures, but water flow has not been adequate. b. Area is reasonably close to Mount Hood volcano where heat source may be available. c. Faults in this area seem to have favorable affect on localizing hot-water convection systems.
G-3	Geothermal lease area	Low	Hot water less than 212°F (100°C)	a. West side of area, close to Mount Hood volcano, may have potential, but there is no data available as no holes have been drilled in the wilderness.
G-4	Geothermal lease area	High	Hot water less than 212°F (100°C)	a. Testing of Pucci geothermal drill hole in this section was favorable for local space-heating use. b. Temperature at 3,706 ft was 170°F (76.7°C), and hot-water flow was approximately 110 gallons per minute.

MAP SHOWING MINERAL AND GEOTHERMAL RESOURCE POTENTIAL OF THE MOUNT HOOD WILDERNESS, CLACKAMAS AND HOOD RIVER COUNTIES, OREGON

By

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1982

Explanatory pamphlet accompanies map

Interior—Geological Survey, Reston, Va.—1982

For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225

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[2]U.S. Bureau of Mines